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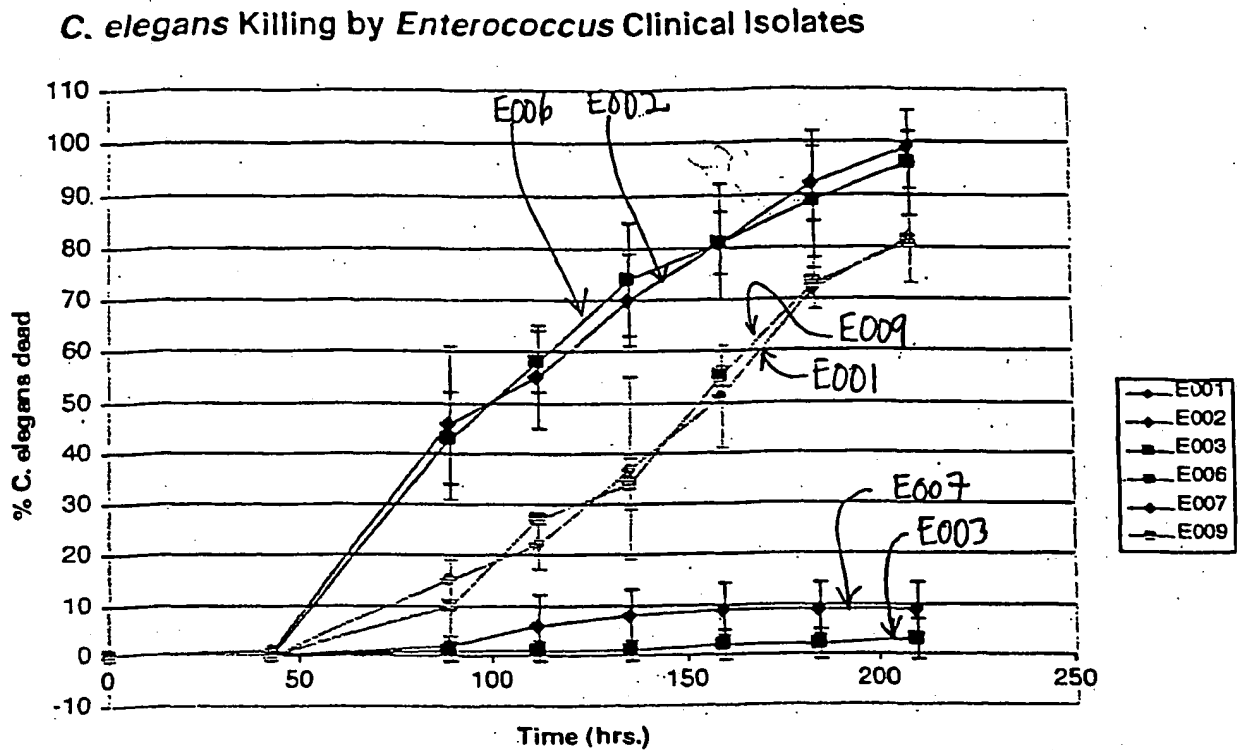
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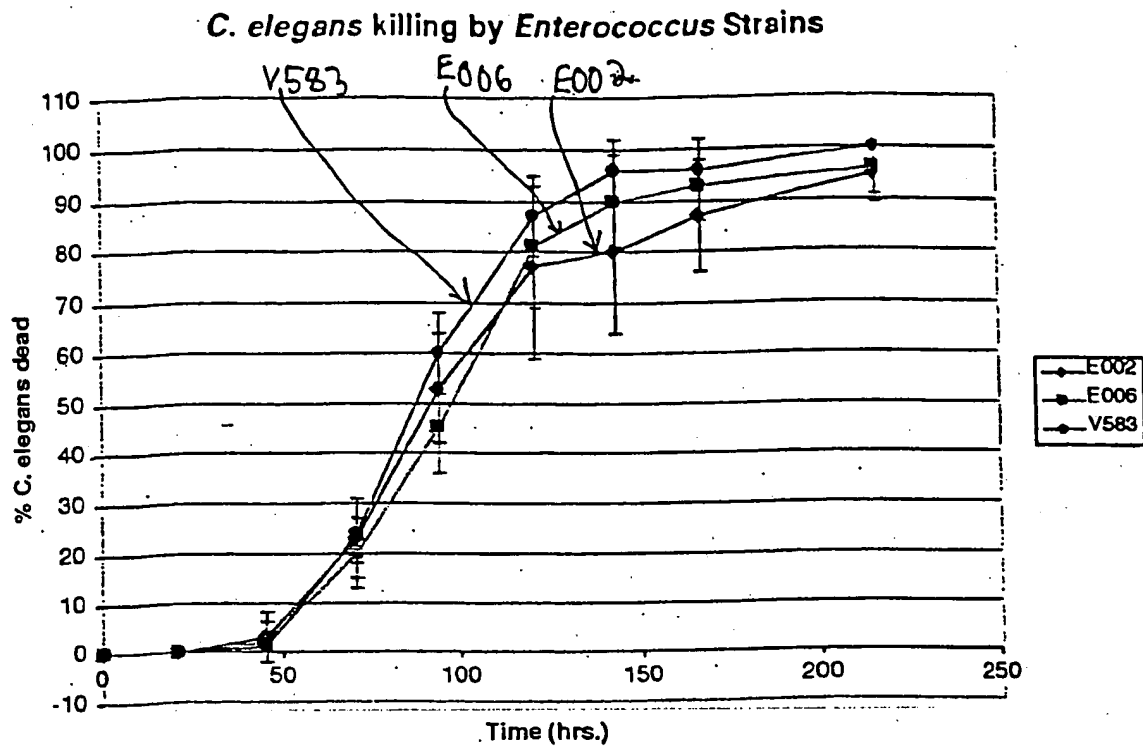
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Figure 1



Title: Enterococcal Virulence Factors
 Applicant(s): Ausubel et al.
 Filing Date: January 16, 2004
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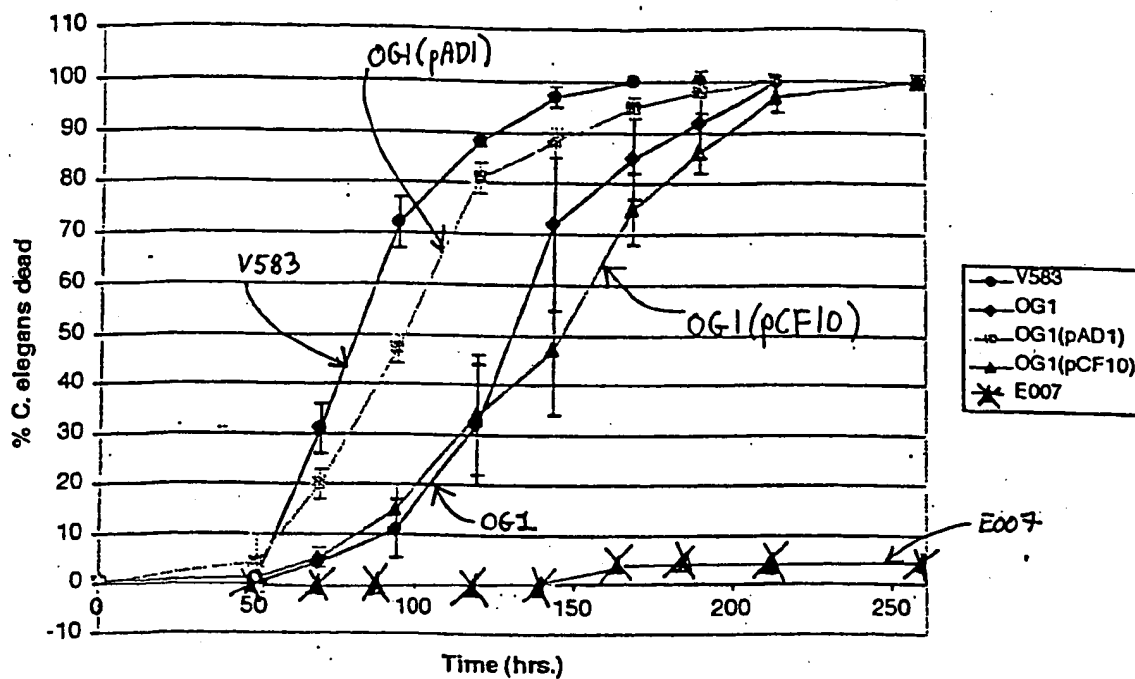
Figure 2



Title: Enterococcal Virulence Factors
Applicant(s): Ausubel et al.
Filing Date: January 16, 2004
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Figure 3

C. elegans Killing by *Enterococcus* Isogenic Strains



Title: Enterococcal Virulence Factors

Applicant(s): Ausubel et al.

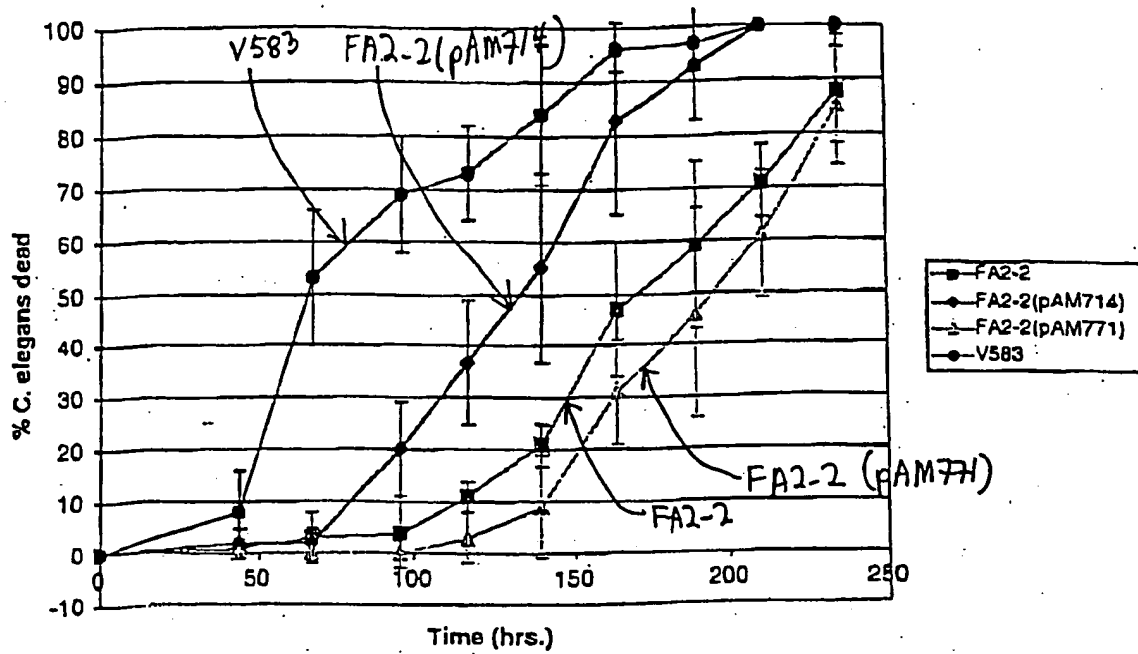
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Figure 4

C. elegans Killing by Isogenic *Enterococcus* Strains Containing Different Conjugative Plasmids: pAD1 vs. pAD1-cyl Δ



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Figure 5A

Photolyase
gaaattgacc gtaaagtcaa tatttacaac attttaagcc tgaatgcgct aggtacgcta 60
tacgaactgg aaaaagatat gagaaaagcg caagtgtatt acgaaaaatc attacaagaa 120
ttggaacaat ttaaattaga atgttccttg gagcgttgta gaatttatta taattctgct 180
aaattctact cggaaatgaa agactaccaa aaaagtgtca ttttaagcga aaaagggatt 240
cagatttgct gtgacaaaca ctccatttat ttgctagatt atcttttata tgaaaaagcc 300
tttaacaaac aaatgctcgg ggaagacaca gccgatgact atcgccaagc ctattatttt 360
acacaatttt ttggcaatac ggaagtcttg caatatattg agaaagatat gaaagctttt 420
aatatttcct attaatttaa tcaaaaagcc gataaaagct gaaaactcag tttttaccgg 480
ctttttgaaa aatataggca agttgctttt aaaaatcagc agtcacggtt acgataagca 540
agacgaagta tttaggagga tttaaaaatg aaaagagtaa tatggtttag acgtgattta 600
cgattacagg ataataaagc attagcacac gcgttacaaa attctgcagc tgatgaattg 660
attttattat tccaaatgaa tcctcaacaa tttattcaag aaagtgtcaa tcataacgct 720
ttttttgcaa gcttagcctc gttcaaagaa cgaatcgatc aagaggcaca tttacaaatc 780
atggtcggcg aaccattaga tttattttca cgtttgaaac gcaaattacc cgattggcag 840
gccattttatt ttaatgaaga tacttgtggc tttggggcaa agcgggacca gcaagctatg 900
cgcttttttg aagaaaataa tattcagctt ttctcttttc aagatgccta tttgcatggc 960
tctgaagaaa ttaagaagaa cgatggcagc aagtaccaag tgtttacgcc ctattacaat 1020
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caaaaccagt ctttagttta tctagactgg ttttgtcacg tacgttatat aaattatgct 2220
tggtgcttga tggcttgtgc gacacgtgct ccatattctg gatttac 2267

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Figure 5B

Photolyase

Met	Lys	Arg	Val	Ile	Trp	Phe	Arg	Arg	Asp	Leu	Arg	Leu	Gln	Asp	Asn
1				5					10						
Lys	Ala	Leu	Ala	His	Ala	Leu	Gln	Asn	Ser	Ala	Ala	Asp	Glu	Leu	Ile
			20					25					30		
Leu	Leu	Phe	Gln	Met	Asn	Pro	Gln	Gln	Phe	Ile	Gln	Glu	Ser	Ala	Asn
		35					40					45			
His	Asn	Ala	Phe	Phe	Ala	Ser	Leu	Ala	Ser	Phe	Lys	Glu	Arg	Ile	Asp
	50					55					60				
Gln	Glu	Ala	His	Leu	Gln	Ile	Met	Val	Gly	Glu	Pro	Leu	Asp	Leu	Phe
65					70					75					80
Ser	Arg	Leu	Lys	Arg	Lys	Leu	Pro	Asp	Trp	Gln	Ala	Ile	Tyr	Phe	Asn
				85					90					95	
Glu	Asp	Thr	Cys	Gly	Phe	Gly	Ala	Lys	Arg	Asp	Gln	Gln	Ala	Met	Arg
			100					105					110		
Phe	Phe	Glu	Glu	Asn	Asn	Ile	Gln	Ser	Phe	Ser	Phe	Gln	Asp	Ala	Tyr
		115					120					125			
Leu	His	Gly	Ser	Glu	Glu	Ile	Lys	Lys	Asn	Asp	Gly	Ser	Lys	Tyr	Gln
	130					135					140				
Val	Phe	Thr	Pro	Tyr	Tyr	Asn	Lys	Trp	Lys	Glu	Ala	Pro	Lys	Glu	Thr
145					150					155					160
Pro	Ile	Pro	Val	Ser	Tyr	Thr	Ala	Glu	Lys	Ile	Phe	Ser	Ala	Cys	Leu
				165					170					175	
Phe	Pro	Glu	Glu	Ala	Ala	Tyr	Arg	Glu	Gln	Ile	Ala	Arg	Arg	Ile	Pro
			180				185					190			
Leu	Thr	His	Tyr	Ser	Val	Gly	Glu	Glu	Thr	Ala	Arg	Arg	Arg	Leu	Asn
	195						200					205			
Thr	Phe	Ile	Asp	Gln	Lys	Leu	Gln	Ser	Tyr	Glu	Asn	Lys	Arg	Asp	Phe
	210					215					220				
Pro	Tyr	Gln	Asp	Gln	Thr	Ser	His	Leu	Ser	Thr	Phe	Leu	Arg	Thr	Gly
225					230						235				240
Glu	Leu	Ser	Ile	Arg	Thr	Ile	Trp	Gln	Glu	Leu	Ala	Ser	Val	Pro	Ser
				245					250					255	
Ser	Leu	Ser	Lys	Glu	Thr	Phe	Lys	Lys	Glu	Leu	Ala	Trp	Arg	Asp	Phe
			260					265					270		
Tyr	Asn	Met	Ile	Tyr	Ser	Ala	Phe	Pro	Gln	Gln	Lys	Glu	Glu	Ala	Ile
	275						280					285			
Gln	Glu	Lys	Phe	Arg	Tyr	Ile	Gln	Trp	Thr	Asn	Asp	Pro	Glu	Met	Phe
	290					295					300				
Val	Lys	Trp	Gln	Lys	Gly	Glu	Thr	Gly	Tyr	Pro	Ile	Ile	Asp	Ala	Ala
305					310					315					320
Met	Arg	Gln	Leu	Asn	Gln	Thr	Gly	Trp	Met	His	Asn	Arg	Leu	Arg	Met
				325					330					335	
Ile	Thr	Ala	Ser	Phe	Leu	Val	Lys	Asn	Leu	His	Ile	Asp	Trp	Arg	Trp
			340					345					350		
Gly	Glu	Lys	Tyr	Phe	Gln	Lys	Met	Leu	Ile	Asp	Tyr	Asp	Ala	Ala	Asn
		355					360					365			
Asn	Ile	Gly	Gly	Trp	Gln	Trp	Ala	Ala	Ser	Thr	Gly	Thr	Asp	Ala	Val
	370					375					380				
Pro	Tyr	Phe	Arg	Ile	Phe	Asn	Pro	Ile	Ile	Gln	Ser	Lys	Lys	Phe	Asp
385					390					395					400
Asn	Asp	Gly	Gln	Phe	Ile	Lys	Lys	Tyr	Val	Pro	Glu	Leu	Lys	Gln	Val
				405					410					415	
Pro	Gln	Lys	Tyr	Ile	His	Gln	Pro	Asn	Leu	Met	Asn	Glu	Ala	Leu	Gln
			420					425					430		
Thr	Gln	Tyr	His	Val	His	Leu	Gly	Glu	Asn	Tyr	Pro	Lys	Pro	Ile	Val
		435					440					445			
Asp	Tyr	Ala	Ser	Ser	Lys	Lys	Gln	Thr	Leu	Phe	Leu	Tyr	Glu	Ala	Ser
	450					455					460				
Lys	Glu	Ile	His	Gln	Glu	Met	Asn	Asn	Pro	Arg	Phe	Gln			
465					470					475					

Figure 6A

ScrR
 ccttttgaaa atttagatga aggatttgat gtctacgcca ctcaagcctt taatgcgcca 60
 gatggctcgtg cacttgcggt cagttggatt gggttgccag aaatcactta cccaagtgat 120
 gtggagggtt gggcaaatgg ctttaagtctg gttaaagaac tcacaattca caacgggaaa 180
 ctatttcaat atccagtttc tgaacagaa atgcttcgtc aatccgctac tactttatca 240
 aatggctgcc atttcttate tactgcttct tttgaattag aagtggatat tcccaaaaaat 300
 gagattgctt ttattcggct tttagcgaac gaaacgggtt caaaaggact ttttaattaca 360
 attgatacga ttcattggtaa aataaccctt gatcgaacat ttgctggcca atcttttgct 420
 gaaaagtatg gcacaattcg tgaactaaa attaggaaaa ataagtcagt tcagttaact 480
 atttttgttg attgctctgt tgcagaaatc tatgtaaata aaggtgaaaa aacgatgact 540
 ggtcgtctct ttccagataa agcgcaacag tatcttcac tatccaagac ggcaaaagct 600
 tgtttttatg agctggaaaa tacgaataat taggaatgat ggtgaatttt gatgggtggt 660
 aaattaacgg atgtatgcaa gcttgctggg gtgagccga caacggtaag ccgctgatt 720
 aataattatg gttatccttag tcaaaaaaca attgataaag ttcattcaagc gatggaagaa 780
 ttaaattatc aacctaatgg attagccaga agcctccaag gaaaaagtac gcagctgatt 840
 ggttttagtct tcccttctgt tagtcatcca ttttttggtg aattaattga aacactggaa 900
 agaaagctct ttgttcaagg atataaagtg attttatgtg atagtgaaaa agatccagaa 960
 aaagagcgcg cctattttacg aatgctcgtc gcaataaag tggacgggtg aatcactggt 1020
 agccataact tagctattaa cgaatatgaa aatgtttcac tacctattgt ttcctttgac 1080
 cgttttctgg cacttgcaaa tccaattgtc tcttcgcaaa actttcaagg gggccaaaaa 1140
 gccactgaag ccttatttgc aagtgggtgca caaaagattg caattattac tgggtgctaat 1200
 aacacaggcg cacctagcga ttatcgattg gctgggtata aacaaacaat ggaaaaatat 1260
 ggcgcagaaa aaacgattct acaaatgtat aatgggacct caacaacatt aaaaaatcta 1320
 gaaatcgaac gtttgcttca aaataaaaact gtagacggca tcttttgtac agatgatttg 1380
 acagcaatta cagttatgaa tattgtctaa aaattgaaga tatccattcc tgaagaatta 1440
 aaagtaattg gttatgatgg gacaaaatta atcaaaagaa ttgccccaca actatcaacc 1500
 attgtgcagc caatcgacga gatgtgtgac gttatgattg acttactgct tcgtagaatg 1560
 aaggatcctg atgttgcaact tgaggaaaaat tatcctatct cgattcagct atcattgtct 1620
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 aatacaccga gcattagtaa aacataccac caatttttgg cgctataggt ttcattttta 1800
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 tttcaaaatt gcttgatctt ctg 2543

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Figure 6B

ScrR

Met	Val	Val	Lys	Leu	Thr	Asp	Val	Ala	Lys	Leu	Ala	Gly	Val	Ser	Pro
1				5					10					15	
Thr	Thr	Val	Ser	Arg	Val	Ile	Asn	Asn	Tyr	Gly	Tyr	Leu	Ser	Gln	Lys
			20					25					30		
Thr	Ile	Asp	Lys	Val	His	Gln	Ala	Met	Glu	Glu	Leu	Asn	Tyr	Gln	Pro
		35					40					45			
Asn	Gly	Leu	Ala	Arg	Ser	Leu	Gln	Gly	Lys	Ser	Thr	Gln	Leu	Ile	Gly
	50					55					60				
Leu	Val	Phe	Pro	Ser	Val	Ser	His	Pro	Phe	Phe	Gly	Glu	Leu	Ile	Glu
65					70					75					80
Thr	Leu	Glu	Arg	Lys	Leu	Phe	Val	Gln	Gly	Tyr	Lys	Val	Ile	Leu	Cys
			85						90					95	
Asp	Ser	Glu	Lys	Asp	Pro	Glu	Lys	Glu	Arg	Ala	Tyr	Leu	Arg	Met	Leu
			100					105					110		
Ala	Ala	Asn	Lys	Val	Asp	Gly	Val	Ile	Thr	Gly	Ser	His	Asn	Leu	Ala
		115					120						125		
Ile	Asn	Glu	Tyr	Glu	Asn	Val	Ser	Leu	Pro	Ile	Val	Ser	Phe	Asp	Arg
	130					135						140			
Phe	Leu	Ala	Pro	Gly	Ile	Pro	Ile	Val	Ser	Ser	Gln	Asn	Phe	Gln	Gly
145					150					155					160
Gly	Gln	Lys	Ala	Thr	Glu	Ala	Leu	Phe	Ala	Ser	Gly	Ala	Gln	Lys	Ile
			165					170						175	
Ala	Ile	Ile	Thr	Gly	Ala	Asn	Asn	Thr	Gly	Ala	Pro	Ser	Asp	Tyr	Arg
			180					185					190		
Leu	Ala	Gly	Tyr	Lys	Gln	Thr	Met	Glu	Lys	Tyr	Gly	Ala	Glu	Lys	Thr
		195					200					205			
Ile	Leu	Gln	Ile	Asp	Asn	Gly	Thr	Ser	Thr	Thr	Leu	Lys	Asn	Leu	Glu
	210					215					220				
Ile	Glu	Arg	Leu	Leu	Gln	Asn	Lys	Thr	Val	Asp	Gly	Ile	Phe	Cys	Thr
225					230					235					240
Asp	Asp	Leu	Thr	Ala	Ile	Thr	Val	Met	Asn	Ile	Ala	Gln	Lys	Leu	Lys
			245					250						255	
Ile	Ser	Ile	Pro	Glu	Glu	Leu	Lys	Val	Ile	Gly	Tyr	Asp	Gly	Thr	Lys
			260					265					270		
Leu	Ile	Lys	Arg	Ile	Ala	Pro	Gln	Leu	Ser	Thr	Ile	Val	Gln	Pro	Ile
		275					280					285			
Asp	Glu	Met	Cys	Asp	Val	Met	Ile	Asp	Leu	Leu	Leu	Arg	Arg	Met	Lys
	290					295					300				
Asp	Pro	Asp	Val	Ala	Leu	Glu	Glu	Asn	Tyr	Pro	Ile	Pro	Ile	Gln	Leu
305					310					315					320
Ser	Leu	Ser	Glu	Ser	Cys										
				325											

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Figure 7A

OppA

ctgcgccgtg	caagcgattt	tgtttatcac	gctttgtcgg	attgcaggga	taccagccaa	60
atggcaatcg	ggattatatg	tttctacaca	ttatacaggc	tgtcatgatt	gggcacaatt	120
ttatataaaa	cgttacggct	ggctctttgc	ggatttgtct	tttgccggag	gtgcttaccg	180
agacggggat	agacagcggg	ggaatcatta	tttcggcaat	ttagatgttt	ttagaatggg	240
cgcaaatagt	gagatccagg	cagactttca	gccggcaaaa	atgcaattgc	gtgcagaccc	300
aattgacaac	cagcggggag	aatttgagta	cgaaaatgag	ggcttgccct	acgcatgctt	360
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ggttgtggca	caacagcaga	aacaaaaata	gacgagaaag	caactgagaa	aaccagtgtc	540
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atgactttct	tagaaagctc	agttagtggg	aaccgtatga	actattctag	cccaacgttt	1860
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acattaatta	aagctgaaaa	agtattgggt	gaagaagatg	ccgctttaat	tcctttatac	1980
caagaggccc	gtagtacgtc	tgtacgacca	gggtgtcaaa	gtattcagta	tcataacttc	2040
gggtgcaacga	gcacatataa	gtatgcctat	aaagaatgaa	ttagtgaaca	aaagtacctt	2100
tagctgaagg	tacttttttt	ccgataagag	cttctttttt	gttaatagtc	aacaattaat	2160
aaaaaaataa	ttgaaaaagg	ttgacaaaaa	taatgatact	cgttagaata	agcactgtta	2220
acaaatgaat	agcgttttca	tgtgactaga	taatactagg	catggaagaa	tttcgtaata	2280
caatgtgggtg	tacaatgggt	acgcaacatg	tttaacggga	ttgttctatg	ctttttttgt	2340
tgttttcact	gaaaaatgta	gaattacttc	tgcaagaagag	ggtcatttat	gaaaattaaa	2400
aaggtgctaa	atcaaaaatg	tgtacttggt	cttgacgaag	gacaggagaa	agtagctgtc	2460
ggtaaaaggcg	tcgggtttta	taagactaaa	aatgatgtct	tatctcgaca	attgggtggag	2520
cggatgtttg	tgatggagcc	agaaggactg	aaaaaacttc	aagtactgct	atcacaaatt	2580
gaagacaaat	acttttttag	agtgaagaaa	ttatccaaca	tgctgaaacg	gtattgggtg	2640
aaaagttgae	tgaacatatt	aatattgggt	tgagtgatca	cattgctttt	gcagctgaaa	2700
atattcaaaa	taatattatt	gttcggaaca	agcttttaag	tgaaattgag	attttatata	2760
gtgaagaatt	tgctattgct	caatgggctg	tagaatattt	aacacaaacc	ttagagattc	2820
catttagtta	tgatgaagcg	gggtatatgg	cgattcatat	ccatagtgtc	cgcagcgggc	2880
gtactgataa	tagtaaaagt	atccgtgaag	ttacaatcgt	ttctgaaatt	attcatttaa	2940
tcgagcagga	attggctatt	gatattcatg	atgataaaaa	tagtctcagt	tattcacgtt	3000
tggtgaatca	tttacgtttg	tttattcatc	gcttccaaca	aatcaatac	gctgttttag	3060
atga						3064

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Figure 7B

OppA
Met Lys Lys Leu Lys Met Met Gly Ile Met Leu Phe Val Ser Thr Val
1 5 10 15
Leu Val Gly Cys Gly Thr Thr Ala Glu Thr Lys Ile Asp Glu Lys Ala
20 25 30
Thr Glu Lys Thr Ser Val Ser Lys Val Leu Asn Leu Met Glu Asn
35 40 45
Ser Glu Ile Gly Ser Met Asp Ser Ile Phe Thr Gln Asp Glu Ala Ser
50 55 60
Ile Asn Ala Gln Ser Asn Val Phe Glu Gly Leu Tyr Gln Leu Asp Glu
65 70 75 80
Lys Asp Gln Leu Ile Pro Ala Ala Ala Lys Glu Met Pro Glu Ile Ser
85 90 95
Glu Asp Gly Lys Arg Tyr Thr Ile Lys Leu Arg Glu Asp Gly Lys Trp
100 105 110
Ser Asn Gly Asp Ala Val Thr Ala Asn Asp Phe Val Phe Ala Trp Arg
115 120 125
Lys Leu Ala Asn Pro Lys Asn Gln Ala Asn Tyr Phe Phe Leu Leu Glu
130 135 140
Gly Thr Ile Leu Asn Gly Thr Ala Ile Thr Lys Glu Glu Lys Ala Pro
145 150 155 160
Glu Glu Leu Gly Val Lys Ala Leu Asp Asp Tyr Thr Leu Glu Val Thr
165 170 175
Leu Glu Lys Pro Val Pro Tyr Phe Thr Ser Leu Leu Ala Phe Ser Pro
180 185 190
Phe Phe Pro Gln Asn Glu Ala Phe Val Lys Glu Lys Gly Gln Ala Tyr
195 200 205
Gly Thr Ser Ser Glu Met Ile Val Ser Asn Gly Pro Phe Leu Met Lys
210 215 220
Asn Trp Asp Gln Ser Ala Met Ser Trp Asp Phe Val Arg Asn Pro Tyr
225 230 235 240
Tyr Tyr Asp Lys Glu Lys Val Lys Ser Glu Thr Ile His Phe Glu Val
245 250 255
Leu Lys Glu Thr Asn Thr Val Tyr Asn Leu Tyr Glu Ser Gly Glu Leu
260 265 270
Asp Val Ala Val Leu Thr Gly Asp Phe Ala Lys Gln Asn Arg Asp Asn
275 280 285
Pro Asp Tyr Glu Ala Ile Glu Arg Ser Lys Val Tyr Ser Leu Arg Leu
290 295 300
Asn Gln Lys Arg Asn Glu Lys Pro Ser Ile Phe Ala Asn Glu Asn Val
305 310 315 320
Arg Lys Ala Leu Ala Tyr Ala Leu Asp Lys Lys Ser Leu Val Asp Asn
325 330 335
Ile Leu Ala Asp Gly Ser Lys Glu Ile Tyr Gly Tyr Ile Pro Glu Lys
340 345 350
Phe Val Tyr Asn Pro Glu Thr Asn Glu Asp Phe Arg Gln Glu Ala Gly
355 360 365
Ala Leu Val Lys Thr Asp Ala Lys Lys Ala Lys Glu Tyr Leu Asp Lys
370 375 380
Ala Lys Ala Glu Leu Asn Gly Asp Val Ala Ile Glu Leu Leu Ser Arg
385 390 395 400
Asp Gly Asp Ser Asp Arg Lys Val Ala Glu Phe Ile Gln Gly Gln Leu
405 410 415
Gln Glu Thr Leu Pro Gly Leu Thr Ile Asn Val Lys Thr Val Pro Leu
420 425 430
Asn Asn Ala Ile Glu Leu Met Arg Lys Gly Asp Tyr Glu Leu Ser Val
435 440 445
Gly Met Trp Gly Pro Asp Tyr Gln Asp Pro Met Thr Phe Leu Glu Ser
450 455 460
Ser Val Ser Gly Asn Arg Met Asn Tyr Ser Ser Pro Thr Phe Asp Gln

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465					470					475				480
Leu	Ile	Glu	Glu	Ala	Thr	Thr	Lys	Tyr	Ala	Asn	Glu	Pro	Glu	Thr Arg
				485					490				495	
Trp	Gln	Thr	Leu	Ile	Lys	Ala	Glu	Lys	Val	Leu	Val	Glu	Glu	Asp Ala
			500					505					510	
Ala	Leu	Ile	Pro	Leu	Tyr	Gln	Glu	Ala	Arg	Ser	Gln	Leu	Val	Arg Pro
		515					520					525		
Gly	Val	Lys	Gly	Ile	Gln	Tyr	His	Asn	Phe	Gly	Ala	Thr	Ser	Thr Tyr
	530					535					540			
Lys	Tyr	Ala	Tyr	Lys	Glu									
545					550									

Fig. 7B
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Figure 8A

TcaA

aatcaatgaa	atttaataaaa	aaagcttagt	tagttgcatt	cattgttcaa	atcggttaca	60
ctaagtaagt	aaaaaaatat	aatacaaggt	tcgtcttcag	gggcagggtg	taattcccga	120
ccggtgggtta	tagtccacga	ctcgttttta	acgattgaat	tggtgtaatt	ccaataccga	180
cagtatagtc	tggataaaga	agatagggct	tatttgagac	gctttttcat	cagataatcc	240
tactctattt	ttccctgcag	aaaaataggg	tttttttgta	tgacaaagaa	gcgaatcaaa	300
aagttcgttg	aagatgggtc	cttaattgga	ggatttcaga	tgaacaacaa	ggtacaaaaa	360
atggtcagca	ttgcaatggt	ggccgcaatc	ggtacagtat	tacaatttgt	ggcatttccg	420
attatgccgg	cgttttagttt	tttgaaaatc	gatttttagtg	atattccgat	tctactcgga	480
atgttcttgt	acggaccgtt	agcaggagta	attactgctt	ttgttcgttc	gttgctacac	540
ctgttcttaa	ccggactagc	accgcaaaat	atggtgggag	atttcgctag	cttttttagca	600
agtagtatct	tcaccttgcc	aattttttat	ttctttggta	aaaagaaaaa	tatccgtaca	660
aatcggatag	tgggcttagt	aagtgggac	ttagccttga	caattttcat	gagtattgcg	720
aattattttg	tcattacacc	catttactta	caattatatg	gtgtgaccac	acaacaattt	780
ttaggaacat	ctttagcaag	ctatgtggcg	attggtattg	tgccattcaa	ccttattaaa	840
ggcctcttag	tcagtgggtg	ttttctagta	ctacatgcga	agttattgcc	atggctatca	900
aaaaaacaac	atactattca	gaaaaaaaaca	ccgttaacaa	aataaatgat	aaaaaacctg	960
ctggtgaaca	atgtttgaca	gtgggttttt	aaaatttacg	cctaaaagaa	aagagggtgt	1020
cataatctgt	catcattctg	ttaaaaaata	ctaaaccatc	tgcatgtgaa	ttttaacttt	1080
cccttggtat	gatagaaatc	atcaaagaaa	gaggagtttt	cctgagtga	aaagtgtaaa	1140
aattgtcgtc	acgtgaatcg	tgatacggag	tccttttggtg	aagaatgcgg	cgctccgcta	1200
atgaatgaat	caatgcatca	agaggaaaaac	caagcacaac	catcaatgaa	taaagggaac	1260
gaatctactc	ctctcagatc	aaaaagaagc	tggatctggg	cgtttctttt	tgtgttcac	1320
gttcttggag	cgggtagcta	ttttctcggtg	acgcattatt	tttctaagga	acaacaaatt	1380
tcttatttta	ttgaagcgat	tgagaatggt	gatgcccaag	aattaagtaa	aaaaatgagg	1440
acgaacgagt	ctgaatttca	agtgaatccg	caaagcatta	agcctttaat	cacttattat	1500
caaaaaaatc	caactgagct	aaaaaaatta	gaaaaagcgc	tattaaagga	taaaaagtta	1560
catggtttaa	ctattcgtga	aacaagtcaa	acagcatttt	tctttcaccg	ttatcaattc	1620
attttaacgc	ctgtttctgt	tcagttaacg	acgaatcagc	gcggtgtgac	gctggcaatg	1680
aacgggcggg	aaagtggcac	ttccgactca	accacttatc	aaaaggaatt	gggcccctta	1740
gcgccaggac	aatatacttt	tacagccaca	gtgaaagata	gcaccggcga	acctgttatc	1800
acagaagagt	accgtttatt	agaagaggaa	aattatattt	ctagtattcc	tttagatttt	1860
aaacgaatga	attttggtgt	ggaaagcaat	ctgccagacg	cagatattta	tattaatgat	1920
cggaaagtgt	gtacgctaac	gaatggaagc	aaaacgattg	gccctttggt	ctggtccaaa	1980
gggatgacga	ttcaacttaa	aaagacgatt	aatggagaag	aaattcaaac	atcaaaagaa	2040
acgattgggt	aaaaatgattt	tgtcgaagcg	ctctccgata	atccaacgct	acaattgaat	2100
tttccgttag	ctagcgacta	tgatgcccg	aaagcgctag	aaacctttta	tcaagcattt	2160
gccaaacaag	tgaaaagtca	tacggatagt	acagaatttg	ctaaaaaata	tctcgttggt	2220
ggggaaaata	atcctcaatt	tccttctttt	atagaagcac	ttgaacgatt	acgtgaaaag	2280
aaatcgaccg	atggttcacc	agattttgaa	gtgaccatta	atacgtaca	attggatggt	2340
aaagaaaatt	accatgtcaa	ttattattta	gaagccaaaa	attctaaagc	aaaagaaaat	2400
ggtcttcgtt	atgaatggat	caatggccta	aatgatcaaa	ttcatttagt	caaagaaccg	2460
ttaaaagaag	gacaattaca	gtttgtttcg	atagatgaac	aaacacttgc	ttggctcgaa	2520
aagatactct	aggcaaaaat	gagtgtctaa	ttatttagca	ctcatttttg	cttattttcta	2580
ttgcacgcgt	gggacatttg	cgttacgctt	ttaacacatt	ctcgcgttcg	ttttctggaa	2640
taaattggtg	tcgagcatgc	ggctcgtctt	taaaaaggac	aatcccatga	tcatcataat	2700
caaatatatt	aggcgcataa	acttgacaaa	gtccacaagc	aatacatttt	tcaggaaacta	2760
aacgtgattg	cataaacagt	gacacatcct	atctaaaaga	ggtttactat	ggaagcaact	2820
tttattttag	cgtttattatc	tcattggatac	aaggtacgtg	catcaacttt	gtatcatctt	2880
ttaaaaggca	aacggactag	ctctgttttg	atztatggtt	ttttatatga	ttgtttacgg	2940
ttcattggct	ggtggccaac	gatttccgaa	caagcctatt	ttcaatttct	tgaaaaactt	3000
tcgaaggcga	aacaaattca	gtatcacgaa	gagacaaatg	agattcaact	aacaaaagaa	3060
gggcaactat	ttttaaagga	gcaccatttt	tcggtgctgg	attatcctgc	aattgatctt	3120
tatcgttttg	gcagaagtga	tcgagaaaag	tggcaactca	ttcaatttgc	cgtgcaagtg	3180
acttcatatt	tatcatttga	ggaaaaacag	tatatccac	ttttatcaac	accgattccg	3240
caactatatt	tgaaacgatg	gttacaacaa	gacaagaaag	agcagcgcgt	tcaatcaatc	3300
aaagaagaac	tggtgcgagg	gtttgagtta	ctacctgaag	cagaaagcga	ctatttggtt	3360
gcgcaacttt	ctggttatca	gcaaactggc	aaagttcctc	agcaattaac	aagccataag	3420
acagctcttg	aacagcgttt	gtggcacacg	caagcggttc	atcatttact	gcagttgata	3480

atgtacggag gaaattat

Figure 8A
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Figure 8B

Tcaa

Met	Asn	Glu	Ser	Met	His	Gln	Glu	Glu	Asn	Gln	Ala	Gln	Pro	Ser	Met
1				5					10					15	
Asn	Lys	Gly	Asn	Glu	Ser	Thr	Pro	Leu	Arg	Ser	Lys	Arg	Ser	Trp	Ile
			20					25					30		
Trp	Ala	Phe	Leu	Phe	Val	Phe	Ile	Val	Leu	Gly	Ala	Gly	Ser	Tyr	Phe
	35						40					45			
Leu	Gly	Thr	His	Tyr	Phe	Ser	Lys	Glu	Gln	Gln	Ile	Ser	Tyr	Phe	Ile
	50					55					60				
Glu	Ala	Ile	Glu	Asn	Gly	Asp	Ala	Gln	Glu	Leu	Ser	Lys	Lys	Met	Arg
65				70						75				80	
Thr	Asn	Glu	Ser	Glu	Phe	Gln	Val	Asn	Pro	Gln	Ser	Ile	Lys	Pro	Leu
				85					90					95	
Ile	Thr	Tyr	Tyr	Gln	Lys	Asn	Pro	Thr	Glu	Leu	Lys	Lys	Leu	Glu	Lys
			100					105					110		
Ala	Leu	Leu	Lys	Asp	Lys	Lys	Leu	His	Gly	Leu	Thr	Ile	Arg	Glu	Thr
	115						120					125			
Ser	Gln	Thr	Ala	Phe	Phe	Phe	His	Arg	Tyr	Gln	Phe	Ile	Leu	Thr	Pro
	130					135					140				
Val	Ser	Val	Gln	Leu	Thr	Thr	Asn	Gln	Arg	Gly	Val	Thr	Leu	Ala	Met
145				150						155				160	
Asn	Gly	Arg	Glu	Val	Gly	Thr	Ser	Asp	Ser	Thr	Thr	Tyr	Gln	Lys	Glu
			165						170					175	
Leu	Gly	Pro	Leu	Ala	Pro	Gly	Gln	Tyr	Thr	Phe	Thr	Ala	Thr	Val	Lys
			180					185					190		
Asp	Ser	Thr	Gly	Glu	Pro	Val	Ile	Thr	Glu	Glu	Tyr	Arg	Leu	Leu	Glu
		195					200					205			
Glu	Glu	Asn	Tyr	Ile	Ser	Ser	Ile	Pro	Leu	Asp	Phe	Lys	Arg	Met	Asn
	210					215					220				
Phe	Val	Val	Glu	Ser	Asn	Leu	Pro	Asp	Ala	Asp	Ile	Tyr	Ile	Asn	Asp
225					230					235				240	
Arg	Lys	Val	Gly	Thr	Leu	Thr	Asn	Gly	Ser	Lys	Thr	Ile	Gly	Pro	Leu
			245						250					255	
Phe	Trp	Ser	Lys	Gly	Met	Thr	Ile	Gln	Leu	Lys	Lys	Thr	Ile	Asn	Gly
			260					265					270		
Glu	Glu	Ile	Gln	Thr	Ser	Lys	Glu	Thr	Ile	Gly	Glu	Asn	Asp	Phe	Val
		275					280					285			
Glu	Ala	Leu	Ser	Asp	Asn	Pro	Thr	Leu	Gln	Leu	Asn	Phe	Pro	Leu	Ala
	290					295					300				
Ser	Asp	Tyr	Asp	Ala	Arg	Lys	Ala	Leu	Glu	Thr	Phe	Tyr	Gln	Ala	Phe
305					310					315				320	
Ala	Lys	Gln	Val	Lys	Ser	His	Thr	Asp	Ser	Thr	Glu	Phe	Ala	Lys	Lys
			325						330					335	
Tyr	Leu	Val	Gly	Glu	Asn	Asn	Pro	Gln	Phe	Pro	Ser	Phe	Ile	Glu	
		340					345					350			
Ala	Leu	Glu	Arg	Leu	Arg	Glu	Lys	Lys	Ser	Thr	Asp	Gly	Ser	Pro	Asp
	355					360					365				
Phe	Glu	Val	Thr	Ile	Asn	Thr	Leu	Gln	Leu	Asp	Gly	Lys	Glu	Asn	Tyr
	370					375				380					
His	Val	Asn	Tyr	Tyr	Leu	Glu	Ala	Lys	Asn	Ser	Lys	Ala	Lys	Glu	Asn
385					390					395				400	
Gly	Leu	Arg	Tyr	Glu	Trp	Ile	Asn	Gly	Leu	Asn	Asp	Gln	Ile	His	Leu
			405					410					415		
Val	Lys	Glu	Pro	Leu	Lys	Glu	Gly	Gln	Leu	Gln	Phe	Val	Ser	Ile	Asp
		420					425					430			
Glu	Gln	Thr	Leu	Ala	Trp	Leu	Glu	Lys	Ile	Leu					
	435					440									

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Figure 9A

ScrB

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aatttagata attgacgccg gccgcttcgg caactgtgac aatatcaaag ccagcaaaaag 60
ctttttcttt taattcgctc agaaagtcac tcattcctgg catgtttcta ctagcttttg 120
ttactttggc taattgatct gcccacacag caggtaagtt tgtccaagtc aaatctttct 180
taataaaaatt aatcgcatct acacgaaaac cagcaattcc tttgtttaac caaaaacgaa 240
tcatttgata gatttctttg cgtagttcag gattttccca atttaaatec ggctgttttt 300
tatgaaaggc atgaaagtag taggcatctt cccaggttaa tttttcccaa acactaccac 360
cgaagttaga cgcgcaattt gtaggtgctt ctgcctcttc ttttataata taaaagtctc 420
gaaaacgact ttgaggattt tttaaaacat cttgaaacca agcatgttca tcagatgtat 480
ggtttaccac caaatctaaa ataactttta tgtttcggtt ttttgcttct tcaatgagtt 540
catcgaagtc tgccattgta ccaaaatcgc tagaaatacc ataatagtct gaaatatcat 600
atccattgtc agccattggc gacgggtaca ttggactcag ccaaatcagc gtaattccta 660
aattttctaa gtaatccagt ttttgaataa tgccttgtaa atcaccaatt ccgtcattat 720
tactatccga aaagctacgt ggataaattt gataggccac ttctttttgc caccaatttc 780
tggtcattct gggtctcctc actcttaaac tagtctgtt aattttttct gtaaccgttt 840
ttacattttg tatgatactc gtttttgcgt aatatgtcaa acgtttatca taaataaatg 900
taaattataa tattcttttg atttaaatag atttatatat gttatacgtt tgactttttt 960
ctgatttggt tatactatta gactaactac tattttctaa taaaggagac attacttttg 1020
tcaagcatca tgaaccaatg gacggatgaa ttacgttatg cgccttattc ttcttggaca 1080
tctgtcacc tcgaaaatct aacttctatt atcgcgcaat ctagttggcg ttttaagtat 1140
catattcaac cacagacagg actactaaat gatcccaacg gtttttcgta tttcaataac 1200
cagtggcatt tattttatca agcgtttcct ttccggagtg ttcacggact aaaaagttgg 1260
gccacttaa cttcctccga ctttaattcac tgggattatg aaggaattgc cctttatccc 1320
gactctgaat atgattctca tggcgtctat tcaggctcag ctttaacaat agataaccaa 1380
ctatgtttat tttatacagg aaatgttcgt gatcaaaact ggcaacgatt tgcatatcaa 1440
aatattgcat ggctgaattc tttaggtgcg atcacaaggg aatcaacacc attcctacct 1500
attgacccca attattcttc ccattttcgt gatccgatgg tatttcctta tcaagaagga 1560
cttgttttat taattgggtc tagtgattta aatggacaag gaaaaattgt ggtctatttt 1620
tctaaagatc gaaatgtaca caattttcat caacttggcg aattgacgtt caccaaccaa 1680
gaattaggct acatggttga atgcccacat ttggtattta ttgatggcca gcctgtctta 1740
ttattttgcc cacaaggctc atctccatct gtaaaaagtt atcagaatat ctatccgaat 1800
atgtacacat tggccgaaac gtttgatttg gagaatcttt ctttagttca ggctgggcct 1860
tttgaaaatt tagatgaagg atttgatgtc tacgccactc aagcctttaa tgcgccagat 1920
ggctgtgcac ttgcggtcag ttggattggg ttgccagaaa tcacttacc aagtgatgtg 1980
gagggttggg caaatggctt aagtctgggt aaagaactca caattcacaa cgggaaacta 2040
tttcaatata cagtttctga aacagaaatg cttcgtcaat ccgctactac tttatcaaat 2100
ggctgccatt tcttatctac tgcttctttt gaattagaag tggatattcc caaaaatgag 2160
attgctttta ttcggttttt agcgaacgaa acgggttcaa aaggactttt aattacaatt 2220
gatacgattc atggtaaaat aacccttgat cgaacatttg ctggccaatc ttttgctgaa 2280
aagtatggca caattcgtga aactaaaaat aggaaaaata agtcagttca gtttaactat 2340
tttggtgatt gctctgttgc agaaaatctat gtaaaataag gtgaaaaaac gatgactggt 2400
cgcttctttc cagataaagc gcaacagtat cttcatctat ccaagacggc aaaagcttgt 2460
ttttatgagc tggaaaatac gaataattag gaatgatggt gaattttgat ggtggttaaa 2520
ttaacggatg tagcaaagct tgctggggtg agcccgacaa cggttaagccg cgtgattaat 2580
aattatgggt atcttagtca aaaaacaatt gataaagttc atcaagcgat ggaagaatta 2640
aattatcaac ctaatggatt agccagaagc ctccaaggaa aaagtacgca gctgattggt 2700
ttagtcttcc cttctgttag tcatccattt tttggtgaat taattgaaac actggaaaga 2760
aagctctttg ttcaaggata taaagtgatt ttatgtgata gtgaaaaaga tccagaaaaa 2820
gagcgcgcct atttacgaat gctcgtgca aataaagtgg acggtgtaat cactggttagc 2880
cataacttag ctattaacga atatgaaaat gtttctactc ctattgtttc ctttgaccgt 2940
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actgaagcct tatttgcaag tgggtgcacaa aagattgcaa ttattactgg tgctaataac 3060
acaggcgcac ctagcgatta tcgattggct ggttataaac aaacaatgga aaaatatggc 3120
gcagaaaaaa cgattctaca aattgataat gggacctcaa caacattaaa aaatctagaa 3180
atcgaacggt tgcttcaaaa taaaactgta gacggcatct tttgtacaga tgatttgaca 3240
gcaattacag ttatgaatat tgctcaaaaa ttgaagatat ccattcctga agaattaaaa 3300
gtaattgggt atgatgggac aaaattaatc aaaagaattg cccacaaact atcaaccatt 3360
gtgcagccaa tcgacgagat gtgtgacgtt atgattgact 3400

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Figure 9B

ScrB
 Met Ser Ser Ile Met Asn Gln Trp Thr Asp Glu Leu Arg Tyr Ala Pro
 1 5 10 15
 Tyr Ser Ser Trp Thr Ser Ala His Leu Glu Asn Leu Thr Ser Ile Ile
 20 25 30
 Ala Gln Ser Ser Trp Arg Phe Lys Tyr His Ile Gln Pro Gln Thr Gly
 35 40 45
 Leu Leu Asn Asp Pro Asn Gly Phe Ser Tyr Phe Asn Asn Gln Trp His
 50 55 60
 Leu Phe Tyr Gln Ala Phe Pro Phe Gly Ser Val His Gly Leu Lys Ser
 65 70 75 80
 Trp Ala His Leu Thr Ser Ser Asp Leu Ile His Trp Asp Tyr Glu Gly
 85 90 95
 Ile Ala Leu Tyr Pro Asp Ser Glu Tyr Asp Ser His Gly Val Tyr Ser
 100 105 110
 Gly Ser Ala Leu Thr Ile Asp Asn Gln Leu Cys Leu Phe Tyr Thr Gly
 115 120 125
 Asn Val Arg Asp Gln Thr Trp Gln Arg Phe Ala Tyr Gln Asn Ile Ala
 130 135 140
 Trp Leu Asn Ser Leu Gly Ala Ile Thr Lys Glu Ser Thr Pro Phe Leu
 145 150 155 160
 Pro Ile Asp Pro Asn Tyr Ser Ser His Phe Arg Asp Pro Met Val Phe
 165 170 175
 Pro Tyr Gln Glu Gly Leu Val Leu Leu Ile Gly Ala Ser Asp Leu Asn
 180 185 190
 Gly Gln Gly Lys Ile Val Val Tyr Phe Ser Lys Asp Arg Asn Val His
 195 200 205
 Asn Phe His Gln Leu Gly Glu Leu Thr Phe Thr Asn Gln Glu Leu Gly
 210 215 220
 Tyr Met Val Glu Cys Pro Asn Leu Val Phe Ile Asp Gly Gln Pro Val
 225 230 235 240
 Leu Leu Phe Cys Pro Gln Gly Leu Ser Pro Ser Val Lys Ser Tyr Gln
 245 250 255
 Asn Ile Tyr Pro Asn Met Tyr Thr Leu Ala Glu Thr Phe Asp Leu Glu
 260 265 270
 Asn Leu Ser Leu Val Gln Ala Gly Pro Phe Glu Asn Leu Asp Glu Gly
 275 280 285
 Phe Asp Val Tyr Ala Thr Gln Ala Phe Asn Ala Pro Asp Gly Arg Ala
 290 295 300
 Leu Ala Val Ser Trp Ile Gly Leu Pro Glu Ile Thr Tyr Pro Ser Asp
 305 310 315 320
 Val Glu Gly Trp Ala Asn Gly Leu Ser Leu Val Lys Glu Leu Thr Ile
 325 330 335
 His Asn Gly Lys Leu Phe Gln Tyr Pro Val Ser Glu Thr Glu Met Leu
 340 345 350
 Arg Gln Ser Ala Thr Thr Leu Ser Asn Gly Cys His Phe Leu Ser Thr
 355 360 365
 Ala Ser Phe Glu Leu Glu Val Asp Ile Pro Lys Asn Glu Ile Ala Phe
 370 375 380
 Ile Arg Leu Leu Ala Asn Glu Thr Gly Ser Lys Gly Leu Leu Ile Thr
 385 390 395 400
 Ile Asp Thr Ile His Gly Lys Ile Thr Leu Asp Arg Thr Phe Ala Gly
 405 410 415
 Gln Ser Phe Ala Glu Lys Tyr Gly Thr Ile Arg Glu Thr Lys Ile Arg
 420 425 430
 Lys Asn Lys Ser Val Gln Leu Thr Ile Phe Val Asp Cys Ser Val Ala
 435 440 445
 Glu Ile Tyr Val Asn Lys Gly Glu Lys Thr Met Thr Gly Arg Phe Phe
 450 455 460
 Pro Asp Lys Ala Gln Gln Tyr Leu His Leu Ser Lys Thr Ala Lys Ala

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465

470

475

480

Cys Phe Tyr Glu Leu Glu Asn Thr Asn Asn
485 490

Fig. 9B
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Figure 10A

RecQ

```

ccgcggctgt ggggtgtatcg ggattggcga ggcgaagaag cgacgcttcc ttatttagat 60
tttcggttat atcaaatcca acaaatTTTg caagaaaagg agtgagtgtt gttgacatta 120
gaacaagaat tattcactca atttggttac gcagcgTTta agcctggtca aaaagaagtg 180
attacaaact tacttgacgg tatgaataca ttggctgttt tgccaacagg gactggaaaa 240
tcatttgtgt atcaatttgt gggccagaag ttagagggac taacggtaat tgtttctccc 300
ttactttcgt taatggaaga tcagatgcgt caattacaaa gacaaggaat taaaggtgcg 360
gttgcttaa acagtacgtt acagtattca gaaaagcggt atatttttagc gaaaatgttc 420
caatacagatt atctgttttt aagcccagaa atgcttttgc agcaagaagt acttagtgtg 480
ttacaacgcc aaaaaattgc attattttgt gtggatgaag ccatttgtgt ttatcagtgg 540
ggcgtcgatt ttcgccctga atatagttaa ttgatctgg tccaaaaaca gctagacttt 600
cctttgacct tggcgTTa ac tgccacagcg acaccgTTg tacagcacgc aattataaaa 660
caattatttt ctcatggcag ctatcaagaa gttctttctt cagtgaatcg aaaaaatatt 720
ggcttgttcg tgaaggaaac gtcagaaaaa gaagaagtgt tactagatta cttatctaaa 780
acggctggta aaatcattat ctattgcgcc acgcgcaaca aaacagaaca aatcagtcaa 840
cttattcagg caaaaaccag ttttaaggta gcctattatc atgggggctt ggaggctagt 900
gaacgtagtc gcttgcaaga acaatttatt gataatcaaa tcgatattct ttgtgcaacg 960
aatgcttttg ggaatgggaat cgacaaacct gatgttcgtg gagtgttca ttttgatttg 1020
cctgatagct tagaaaatta cctgcaagaa atcgggagag ctggacgtga tggTcaaaaa 1080
agttgggcgc tattattgta taaaaaaggg gatgaattta ttcacggtt tttcttagaa 1140
gagacaagag cgaatcgagc gaccttaaaa tcgctgattg aaggagaaga acaagcaggt 1200
ttgctagaaa atgccaccga gttacaacaa aaatgggtcc aaggctattt agccaaggat 1260
tattcttttg aagagctaga gcatcgTTta gaggagaaag aaaaagatcg ccaagcaca 1320
ttaagagga tgctgacgta tattgaaacc acaacctgtc gaagaacgtt gattcaaaact 1380
tattttcaag aaccgattgt caaacaatca ccggaaactt gttgtgataa ttgtgcgtta 1440
ttctttgaca tttaccaaga ttcaatagta aaatcgaaac agaccagcaa tcaaaatgaa 1500
gaaggttggc gttctaaatt tctaaaatta tttaaagaac gtgattaaatt catTTTTtta 1560
gtcggcagtt ggcaaaagct atgatataat aacaagcgag agaagtttag gaggaaatta 1620
gcagtgagta aaaaggacaa aaagaaaaac caagctcgTg agccatggga acaatcaatt 1680
tatgaacctg atcaaaatgg tggTggttct cgttttagcaa aacgccaaca gcaacgagga 1740
aattcattat ttctaactgt tttagttatt ttgctattat taattattgc cattccaatt 1800
gggactttct tatggatgat gcaagacaag aaaccgaacg aaagtgttag caaaaaatagc 1860
cagccatctt cttcattagt ccaatcatca tcaaaagaga agaaaaaaga aagtacgtca 1920
aaatcagtgg aaagctcaga accagcaagc agccaaccag ctgaaaatac aacaccttca 1980
agttcagatg ctgctgcaca gcaacaacag gaccaacaag cacaacaaca gcaacagcaa 2040
caacaagagc agcaacaaca acaagaagct caaaatcaac aacagcaac 2089

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Figure 10B

RecQ
 Met Asn Thr Leu Ala Val Leu Pro Thr Gly Thr Gly Lys Ser Leu Cys
 1 5 10 15
 Tyr Gln Phe Val Gly Gln Lys Leu Glu Gly Leu Thr Val Ile Val Ser
 20 25 30
 Pro Leu Leu Ser Leu Met Glu Asp Gln Met Arg Gln Leu Gln Arg Gln
 35 40 45
 Gly Ile Lys Gly Ala Val Ala Leu Asn Ser Thr Leu Gln Tyr Ser Glu
 50 55 60
 Lys Arg Tyr Ile Leu Ala Lys Met Phe Gln Tyr Asp Tyr Leu Phe Leu
 65 70 75 80
 Ser Pro Glu Met Leu Leu Gln Gln Glu Val Leu Ser Val Leu Gln Arg
 85 90 95
 Gln Lys Ile Ala Leu Phe Val Val Asp Glu Ala His Cys Val Tyr Gln
 100 105 110
 Trp Gly Val Asp Phe Arg Pro Glu Tyr Ser Lys Leu Asp Leu Val Gln
 115 120 125
 Lys Gln Leu Asp Phe Pro Leu Thr Leu Ala Leu Thr Ala Thr Ala Thr
 130 135 140
 Pro Val Val Gln His Ala Ile Ile Lys Gln Leu Phe Ser His Gly Ser
 145 150 155 160
 Tyr Gln Glu Val Leu Ser Ser Val Asn Arg Lys Asn Ile Gly Leu Phe
 165 170 175
 Val Lys Glu Thr Ser Glu Lys Glu Glu Val Leu Leu Asp Tyr Leu Ser
 180 185 190
 Lys Thr Ala Gly Lys Ile Ile Ile Tyr Cys Ala Thr Arg Asn Lys Thr
 195 200 205
 Glu Gln Ile Ser Gln Leu Ile Gln Ala Lys Thr Ser Phe Lys Val Ala
 210 215 220
 Tyr Tyr His Gly Gly Leu Glu Ala Ser Glu Arg Ser Arg Leu Gln Glu
 225 230 235 240
 Gln Phe Ile Asp Asn Gln Ile Asp Ile Leu Cys Ala Thr Asn Ala Phe
 245 250 255
 Gly Met Gly Ile Asp Lys Pro Asp Val Arg Gly Val Ile His Phe Asp
 260 265 270
 Leu Pro Asp Ser Leu Glu Asn Tyr Leu Gln Glu Ile Gly Arg Ala Gly
 275 280 285
 Arg Asp Gly Gln Lys Ser Trp Ala Leu Leu Leu Tyr Lys Lys Gly Asp
 290 295 300
 Glu Phe Ile His Arg Phe Phe Leu Glu Glu Thr Arg Ala Asn Arg Ala
 305 310 315 320
 Thr Leu Lys Ser Leu Ile Glu Gly Glu Glu Gln Ala Gly Leu Leu Glu
 325 330 335
 Asn Ala Thr Glu Leu Gln Gln Lys Trp Val Gln Gly Tyr Leu Ala Lys
 340 345 350
 Asp Tyr Ser Phe Glu Glu Leu Glu His Arg Leu Glu Glu Lys Glu Lys
 355 360 365
 Asp Arg Gln Ala Gln Leu Arg Gly Met Leu Thr Tyr Ile Glu Thr Thr
 370 375 380
 Thr Cys Arg Arg Thr Leu Ile Gln Thr Tyr Phe Gln Glu Pro Ile Val
 385 390 395 400
 Lys Gln Ser Pro Glu Thr Cys Cys Asp Asn Cys Ala Leu Phe Phe Asp
 405 410 415
 Ile Tyr Gln Asp Ser Ile Val Lys Ser Asn Lys Thr Ser Asn Gln Asn
 420 425 430
 Glu Glu Gly Trp Arg Ser Lys Phe Leu Lys Leu Phe Lys Glu Arg Asp
 435 440 445

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Figure 11A

LysR

tacttttagct	tctcaaaaagc	tccatacgag	tcaaccttat	ttaagtaccc	agctcaagga	60
gttggaacgt	gaattaggtg	cttcattaat	tttaagagac	aagaaacatt	gtcggctttc	120
tccagcaggc	gaagtcgtcg	ccaagcgaac	agaaatgatt	tttgactca	ttaaggaagc	180
gcaagaagag	attaatgaat	tagtgacca	aggatcgaca	acgaccattc	ggattggaac	240
aaacttaatt	gatatagata	aagcatttgg	agaagtcttg	ttgttattta	atcaatccta	300
tccgtatgta	agtattgatt	ttaagtatta	ttacgatctt	gaaacagcct	tggaaacaga	360
tttaattgac	attgggattg	ggatattttt	ggatacctcg	attccattag	agaaagaatt	420
aatttatata	gaaagctatc	tcctttgtgt	caataaaaaat	catcctttag	cccatgccga	480
tagcgtgacg	attgacgaaa	ttcgttcttt	accttttgct	gcataattccg	atcaagtata	540
tgaaaaaaaaa	gtgttcaaac	gttggaacg	taaaatcaat	tgggaaaatc	ggcaaatcgt	600
catcgaactt	ccttctcttc	atttagtctt	agacatggtc	caacgagaaa	aagcctgtag	660
catccttccc	tattcaactca	ctgatgaact	aaacagacgt	aacttagttg	gtattcctct	720
ggaagatagt	ccagaacgag	ccatctatct	agttcagaat	aatcatcacg	gacattgtga	780
agcacaccgt	tatttattcg	aacaattacg	ttattttattc	taggaataga	aaaaggagga	840
attcccattgg	aactattttcg	tttacattat	tttttagagt	tatgcaaagt	gaaacaattt	900
actaaagcag	ccgaaaattt	agcaatttct	caagctgcat	taagtaagca	aataaaaaatt	960
cttgaagcaa	cgttaggcgc	ggaacttttt	aatcgccaag	gccaaactac	caccttaacg	1020
ccagctggat	taattttaga	aaaatattgt	tggcgcatca	ccaatgagtt	ggtctcaatt	1080
gaagaagagc	taaaagaaat	taatcattct	tccaaccata	tttatgtggc	cacttatctc	1140
tgtgatttag	aatataaatt	gaatgactta	ctaatagcaa	cattaacgga	tcgttcatcc	1200
aacttacaag	tccacactat	tattacagaa	aatattcttc	aatccttgga	aacaatggat	1260
gcagattttg	gtatttcoct	tgttgactta	ccattacctg	aacatattgg	taaaattgat	1320
ttatttacag	caaattatca	attcatttta	agaaacgac	atccagcttt	ggcaaaagcc	1380
acgacggaag	aaatttttaa	agaactaaca	atgtaccctt	tcgtccgttt	aaataccgaa	1440
ttttccgagc	aaaacaaatt	aaccaattgg	ctagatacta	cgttttctaa	tttttctcca	1500
gagaaagtca	ttcaagtggg	tactctttca	cttattactc	acttggtgtc	tcattccgat	1560
agtttcgcta	ttgtccccga	atacaciaat	attcaacttt	tagacaattc	gatccataca	1620
ctaacttacc	aagaactacc	taaaacgaaac	atggcagttt	attattttaa	agaacgttac	1680
atgagtcgac	aacttcaaca	acttttggct	gaatgccaaa	aacaatttca	atagtaaaaa	1740
ccaagactag	agcttgtcgg	caagcgagtt	ccagtcttgg	tttttatttg	tgttttcagg	1800
tagcggcttc	tcttcttttg	acaaatccta	aagaagtgat	agccatcact	aacgaagtgc	1860
ctccttgact	taaaaacgga	agcggaatac	cttttaacgg	caacagtcca	atcaccgcac	1920
cgatattctc	caccgtttga	aagaccagcg	aaaaaatgag	ggcgacacag	atgtacatac	1980
aaaaacgcga	attgctccgc	aagccagcta	ctaaaacttg	ataaaacaag	taaaaataga	2040
gaaaaacaac	ggtggcactg	cccacaaagc	cccaggcttc	cccgataaaa	gtaaaa	2096

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Figure 11B

LysR

Met	Glu	Leu	Phe	Arg	Leu	His	Tyr	Phe	Leu	Glu	Leu	Cys	Lys	Val	Lys
1				5					10					15	
Gln	Phe	Thr	Lys	Ala	Ala	Glu	Asn	Leu	Ala	Ile	Ser	Gln	Ala	Ala	Leu
			20					25					30		
Ser	Lys	Gln	Ile	Lys	Ile	Leu	Glu	Ala	Thr	Leu	Gly	Ala	Glu	Leu	Phe
		35					40					45			
Asn	Arg	Gln	Gly	Gln	Thr	Thr	Thr	Leu	Thr	Pro	Ala	Gly	Leu	Ile	Leu
	50					55					60				
Glu	Lys	Tyr	Cys	Trp	Arg	Ile	Thr	Asn	Glu	Leu	Val	Ser	Ile	Glu	Glu
65					70					75					80
Glu	Leu	Lys	Glu	Ile	Asn	His	Ser	Ser	Asn	His	Ile	Tyr	Val	Ala	Thr
				85					90					95	
Tyr	Leu	Cys	Asp	Leu	Glu	Tyr	Lys	Leu	Asn	Asp	Leu	Leu	Met	Thr	Thr
			100					105					110		
Leu	Thr	Asp	Arg	Ser	Ser	Asn	Leu	Gln	Val	His	Thr	Ile	Ile	Thr	Glu
		115					120					125			
Asn	Ile	Leu	Gln	Ser	Leu	Glu	Thr	Met	Asp	Ala	Asp	Phe	Gly	Ile	Ser
	130					135					140				
Phe	Ala	Asp	Leu	Pro	Leu	Pro	Glu	His	Ile	Gly	Lys	Ile	Asp	Leu	Phe
145					150					155					160
Thr	Ala	Asn	Tyr	Gln	Phe	Ile	Leu	Arg	Asn	Asp	His	Pro	Ala	Leu	Ala
				165					170					175	
Lys	Ala	Thr	Thr	Glu	Glu	Ile	Leu	Lys	Glu	Leu	Thr	Met	Tyr	Pro	Phe
			180					185					190		
Val	Arg	Leu	Asn	Thr	Glu	Phe	Ser	Glu	Gln	Asn	Lys	Leu	Thr	Asn	Trp
		195					200					205			
Leu	Asp	Thr	Thr	Phe	Ser	Asn	Phe	Ser	Pro	Glu	Lys	Val	Ile	Gln	Val
	210					215					220				
Asp	Thr	Leu	Ser	Leu	Ile	Thr	His	Leu	Val	Ser	His	Ser	Asp	Phe	Ala
225					230					235					240
Ile	Val	Pro	Glu	Tyr	Thr	Asn	Ile	Gln	Leu	Leu	Asp	Asn	Ser	Ile	His
				245					250					255	
Thr	Leu	Thr	Tyr	Gln	Glu	Leu	Pro	Lys	Arg	Asn	Met	Ala	Val	Tyr	Tyr
		260						265					270		
Leu	Lys	Glu	Arg	Tyr	Met	Ser	Arg	Gln	Leu	Gln	Gln	Leu	Leu	Ala	Glu
		275					280					285			
Cys	Gln	Lys	Gln	Phe	Gln										
	290														

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Figure 12A

XAA-His Dipeptidase

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acaaaaatta ccttcagaat atgatttagc taaagaatat aactgcagtc gcttgaccat 60
ccgtaaagcg attgatgatt tgatccgcaa aaatatatttg gtaaaacgac atggtaaagg 120
tagttatgtg atgtcgcaag cgaaaattca aagtggctgc gctggcttac aagggttttac 180
tgaggcagcc aaagcttacg ggaaaaaaag ccagacagaa gtcatttcct ttgaagaagt 240
agtacatccc gctgagaaaaa ttcgggagcg gctccaagta ggcaaaaatg aggcaattta 300
tgaactgatt cgccgcccga tgtagacgg cgaaccaatg acagttgaaa aaattttattt 360
gccacaggca tacgtacaag gccatacgaa gcaagacttc gagggctctc tttctgctt 420
aatcgagaag aacgtcgaga ttgcttattc gcatcaagaa attgaagcaa tcttagttga 480
agcggaattt tcagaattat tgaatgttcc tgtgggccaa ccacttttac aagtccactc 540
tatcacctat gcgcttgatg caactcctat tttatatgat gtctctttat atcgagcaga 600
tcggtacacg tttaaaaaca cactgacccg ctatagcccc tctgaaaaaca accaagtggg 660
gctaggaggt tcttggaacg aatgaagatc aaagaagaaa tagccgctca aaaagattta 720
ttttatgaag acttaaaaca aattatcgcg attcgaagtg tgaaagggtc gcctaaaaaa 780
gaggcacctt ttggcgagg accgaaaaaga gccttggaag aaacgctgaa acttgcagag 840
cgttatgggt ttcaaaactgg gattgtcaat gacgcagttg gctatgcgca atggggaaca 900
gcggaagaat atctgggaat tattgggtcat ttatagtag taccagaagg ttctgggttg 960
tcagtgcgcg cctttcaatt aacgaaaaaa aatcaacgtt tgtatggtag aggaattcta 1020
gataataaag gtcctatctt ggcttgccgt tatggaatga aattactgaa agaacttggt 1080
taccaacca agaaaaccat tcgcttaatg tttggcacgg atgaagaaag tgggagtggg 1140
gatatcccc tatatattaga gaaggaaaac gcaccggtt ttggatttac tccagattgt 1200
aaatatccag tagtttatgg ggagcgaggg attgttaatt atgagatcac aacgaccata 1260
ccagatgatt caagtgaaca aattgggtcag attatagggt atcaagcaaa agaccacgta 1320
cctgatcaat taagtgtggt gattgcggga aaaacaacag caatcacggg aaaacgtgct 1380
ccttccaatg cgccagaact aggcaagaac gcgattactt tattggcaca gaaaattagc 1440
gaggaacagt tagtcaaagg aaatttatta cagtatttcg actggttaac cgctagtttt 1500
cacgaaaagc actatggcga aggagtagct ctggacttta aggatcagga tagtgggcaa 1560
ttgattttta cgccctatgc gttggaaaaa agaggacagc aattgggtgt atcattggcc 1620
gtgcgttatc ctgtttctat tacagaaaac gaagtaacca cgcagctaac gaaggcacta 1680
tttccagaaa gtgaagtgc cgtcatccgc cgctcccta gtacgtgtt tccaaaagat 1740
gagcgcaatg ttcaaaaatt aaccaaggtt tatgaacaaa ttactggctt agatgggacg 1800
ccagtcacaa ctacaggtgc tacgtatgct cgctttatgc cgaatatcgt tgcttttggt 1860
ccatcatttc ctggtcaaaa aggcatgctg cataaccaag atgaatatat ggatgaaaaa 1920
gatttactgc ttaatctgga aatctatatg caagcgatga ttgcattaac agaagcattaa 1980
aaccaataga agatacacgt atgagaagaa gacaatgtgt ttcgtagagg tcgcatacgt 2040
gtatcttcta tttttctgta taaaatttca ttttcagtat atacaaaaca gtatatacta 2100
gtttataatg gtggagaaat gtaagcgtaa acgaaagggc ggatggaaaa tgacttgggg 2160
tgcaattgcg acatggcgga tggcacatga tgggttacta aaagctacag aagaattaca 2220
acaaggaggt gctgcaggca cggccgtgga acaattaatt aaagaagtag aagactatcc 2280
ttttataaag tcagtggggt acggcggttt acctaattgag gaagggattt tagaaatgga 2340

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Figure 12B

XAA-His Dipeptidase

Met	Lys	Ile	Lys	Glu	Glu	Ile	Ala	Ala	Gln	Lys	Asp	Leu	Phe	Tyr	Glu
1				5					10					15	
Asp	Leu	Asn	Lys	Ile	Ile	Ala	Ile	Arg	Ser	Val	Lys	Gly	Ser	Pro	Lys
		20						25					30		
Lys	Glu	Ala	Pro	Phe	Gly	Glu	Gly	Pro	Lys	Arg	Ala	Leu	Glu	Glu	Thr
	35						40					45			
Leu	Lys	Leu	Ala	Glu	Arg	Tyr	Gly	Phe	Gln	Thr	Gly	Ile	Val	Asn	Asp
	50					55					60				
Ala	Val	Gly	Tyr	Ala	Gln	Trp	Gly	Thr	Ala	Glu	Glu	Tyr	Leu	Gly	Ile
65					70					75					80
Ile	Gly	His	Leu	Asp	Val	Val	Pro	Glu	Gly	Ser	Gly	Trp	Ser	Val	Pro
			85						90					95	
Pro	Phe	Gln	Leu	Thr	Lys	Lys	Asn	Gln	Arg	Leu	Tyr	Gly	Arg	Gly	Ile
			100					105					110		
Leu	Asp	Asn	Lys	Gly	Pro	Ile	Leu	Ala	Cys	Leu	Tyr	Gly	Met	Lys	Leu
	115						120					125			
Leu	Lys	Glu	Leu	Gly	Tyr	Gln	Pro	Lys	Lys	Thr	Ile	Arg	Leu	Met	Phe
	130					135					140				
Gly	Thr	Asp	Glu	Glu	Ser	Gly	Ser	Gly	Asp	Ile	Pro	Leu	Tyr	Leu	Glu
145					150					155					160
Lys	Glu	Asn	Ala	Pro	Val	Phe	Gly	Phe	Thr	Pro	Asp	Cys	Lys	Tyr	Pro
			165						170					175	
Val	Val	Tyr	Gly	Glu	Arg	Gly	Ile	Val	Asn	Tyr	Glu	Ile	Thr	Thr	Thr
		180						185					190		
Ile	Pro	Asp	Asp	Ser	Ser	Glu	Gln	Ile	Gly	Gln	Ile	Ile	Gly	Asp	Gln
		195					200					205			
Ala	Lys	Asp	His	Val	Pro	Asp	Gln	Leu	Ser	Val	Val	Ile	Ala	Gly	Lys
	210					215					220				
Thr	Thr	Ala	Ile	Thr	Gly	Lys	Arg	Ala	Pro	Ser	Asn	Ala	Pro	Glu	Leu
225					230					235					240
Gly	Lys	Asn	Ala	Ile	Thr	Leu	Leu	Ala	Gln	Lys	Ile	Ser	Glu	Glu	Gln
			245						250					255	
Leu	Val	Lys	Gly	Asn	Leu	Leu	Gln	Tyr	Phe	Asp	Trp	Leu	Thr	Ala	Ser
		260						265				270			
Phe	His	Glu	Lys	His	Tyr	Gly	Glu	Gly	Val	Ala	Leu	Asp	Phe	Lys	Asp
	275						280					285			
Gln	Asp	Ser	Gly	Gln	Leu	Ile	Leu	Thr	Pro	Tyr	Ala	Leu	Glu	Lys	Arg
	290					295					300				
Gly	Gln	Gln	Leu	Val	Leu	Ser	Leu	Ala	Val	Arg	Tyr	Pro	Val	Ser	Ile
305					310					315					320
Thr	Glu	Asn	Glu	Val	Thr	Thr	Gln	Leu	Thr	Lys	Ala	Leu	Phe	Pro	Glu
			325						330					335	
Ser	Glu	Val	Thr	Val	Ile	Arg	Arg	Leu	Pro	Ser	Thr	Leu	Phe	Pro	Lys
		340						345					350		
Asp	Glu	Arg	Asn	Val	Gln	Lys	Leu	Thr	Lys	Val	Tyr	Glu	Gln	Ile	Thr
	355						360					365			
Gly	Leu	Asp	Gly	Thr	Pro	Val	Thr	Thr	Thr	Gly	Ala	Thr	Tyr	Ala	Arg
	370					375					380				
Phe	Met	Pro	Asn	Ile	Val	Ala	Phe	Gly	Pro	Ser	Phe	Pro	Gly	Gln	Lys
385					390					395					400
Gly	Ile	Ala	His	Asn	Gln	Asp	Glu	Tyr	Met	Asp	Glu	Lys	Asp	Leu	Leu
			405						410					415	
Leu	Asn	Leu	Glu	Ile	Tyr	Met	Gln	Ala	Met	Ile	Ala	Leu	Thr	Glu	Ala
		420						425					430		

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Figure 13A

SacU

cattttttat	taaattacat	atttgaata	ggaatttcct	gtgaaatgag	gtatcctaag	60
aaaggtgata	aaacacagag	gtaaaggagt	gacacgatga	gtcgtgtaga	tcgttataaa	120
catattcatg	aaaaatcgag	accagcagag	cataaaaaga	cctttaatcc	ccgaaaatca	180
atgggtgaac	atagagaaga	agaaccagaa	gaactagctg	aaagccttca	agagccagtt	240
tacgaagaca	gctatactga	ggacagtcgc	agaagtgaga	ggcgacatca	aacagattca	300
gggtggggca	acggttctga	ccaaccaccc	cgcggaaaaa	aagacaagaa	accaaaaaag	360
aaacgtaaaa	aatcaaaaac	aaaacgcttt	ttcaaatggc	tagtgatcct	attgattctg	420
ttatttgcct	atagtacagt	catgttttta	aaaggaaaat	ctgcagcaga	acatgatgac	480
tcgttgcctc	aagaaaaagt	agaaacattt	aatgggtgtca	aaagtagcaa	cggggctaag	540
aatattttta	ttcttggcag	cgatacacgt	ggggaaagatg	ctggacgagc	cgacacaata	600
atgggttctc	aactaaatgg	accatcaaaa	aaaccgaaat	taatttcatt	tatgcgtgat	660
acattcgtgg	acattcctgg	tgtcgggccc	aataaaatta	atgccgcata	cgcttatggc	720
ggtgctgaat	tgggtcgtga	aacgttaaaa	caaaacttta	atttagatac	gaaatattat	780
gctaaggtag	atttccaatc	atttgaaaaa	attgttgact	ctatgtttcc	aaaaggtgtc	840
aaaatcgatg	cagaaaaatc	actgaattta	gatgggtgtg	atattgaaaa	agggcaacag	900
gtcatggatg	gacatgtctt	acttcaatac	gctcgtctta	ggatggatga	agaaggcgac	960
tttggtcggg	ttcgtcgcca	acaacaagtt	atgtcagctg	taatgagcca	aatgaaaaac	1020
ccaatgactt	tattaagaac	cccagaatca	cttgggaaat	tagtcggcta	tatgtcgaca	1080
gatgtgcctg	ttagtttcat	gttaacgaat	ggaccatcat	tgttgattaa	aggaaaagca	1140
gggggtgagt	cattatcggt	tccggtacca	gattcttgga	attttgggtga	atcctcttat	1200
gcaggcgatg	ttttagaagt	agatgaacaa	aaaaatgctg	acgccatcga	aaaattcctg	1260
aacgaataag	gaaagcattt	taaaatatcc	ttttttatgc	tatattagaa	acaacgtgga	1320
aaattagtga	aacgaggtta	caaaaatgaaa	attgctattg	tgacagatag	tacagcttat	1380
ttacccgagc	gcattaaaga	tcatccgaat	ctttttgtaa	ttcccatccc	agtcatttta	1440
gatggaaaaa	tatacaacga	aggcattgac	attgaagcag	atgaatatta	tgcattgcta	1500
aataatagta	aagaatttcc	gacgacttca	caacctgctt	taggagaagt	gtagagctt	1560
tacaaatcaa	tcgctgaaca	agggtagcag	accatcatca	gcattcatct	ttcttcagga	1620
atctctgggt	ttgttcatac	attgcacgga	cttaccgatg	aaatcccagg	cgttgctttg	1680
tatccatatt	actcaaaaat	tacaagtatg	ccaatgggac	acatggtaga	agctgcttta	1740
gatttaacag	aagaaaaagc	cagcttagaa	gaaatttttg	ccaaattaga	tttaattcgt	1800
gacaatacgt	atgcatatct	aattgtagaa	gatctgaaca	acttagttcg	tggcggtcgc	1860
ttaacgaatg	gcgagcctt	gatcgctgga	ctattgaaga	ttaaacctat	cttgactttt	1920
gaagatggaa	agattgtatt	atttgaaaaa	atccgttcaa	caaagaaagc	ttttgctcgt	1980
gcagaaaaga	ttattgggtga	acgaaaacgca	gggattgaag	caccagttaa	actgtatgtg	2040
attcatgcca	ataaccgcat	cgttgctgaa	aaagaacaag	caaaattaca	aaagctatac	2100
ccaaatgcag	aaattgaaat	tggtcatttt	ggtccagtta	tcgggaccca	cctaggggaa	2160
aaagcaattg	gtttagcgat	ttcagctcaa	taataaaaaga	tgagacaaaa	gtaaactact	2220
tctgtctcat	cttttattct	attattttat	cgttcgtcgtg	tgttactcag	ccgaacactt	2280
tttgtttata	agaaaatgta	aaattactcc	tttttattag	aaaatatctt	gcaaattaag	2340
caattcctta	caaagtaatg	ta				2362

Figure 13B

SacU

Met	Lys	Ile	Ala	Ile	Val	Thr	Asp	Ser	Thr	Ala	Tyr	Leu	Pro	Glu	Arg
1				5					10					15	
Ile	Lys	Asp	His	Pro	Asn	Leu	Phe	Val	Ile	Pro	Ile	Pro	Val	Ile	Leu
		20						25					30		
Asp	Gly	Lys	Ile	Tyr	Asn	Glu	Gly	Ile	Asp	Ile	Glu	Ala	Asp	Glu	Tyr
	35					40					45				
Tyr	Ala	Leu	Leu	Asn	Asn	Ser	Lys	Glu	Phe	Pro	Thr	Thr	Ser	Gln	Pro
	50					55					60				
Ala	Leu	Gly	Glu	Val	Leu	Glu	Leu	Tyr	Lys	Ser	Ile	Ala	Glu	Gln	Gly
65					70					75				80	
Tyr	Asp	Thr	Ile	Ile	Ser	Ile	His	Leu	Ser	Ser	Gly	Ile	Ser	Gly	Phe
			85					90					95		
Val	His	Thr	Leu	His	Gly	Leu	Thr	Asp	Glu	Ile	Pro	Gly	Val	Ala	Leu
			100					105					110		
Tyr	Pro	Tyr	Asp	Ser	Lys	Ile	Thr	Ser	Met	Pro	Met	Gly	His	Met	Val
		115					120					125			
Glu	Ala	Ala	Leu	Asp	Leu	Thr	Glu	Glu	Lys	Ala	Ser	Leu	Glu	Glu	Ile
	130					135					140				
Phe	Ala	Lys	Leu	Asp	Leu	Ile	Arg	Asp	Asn	Thr	Tyr	Ala	Tyr	Leu	Ile
145				150					155					160	
Val	Glu	Asp	Leu	Asn	Asn	Leu	Val	Arg	Gly	Gly	Arg	Leu	Thr	Asn	Gly
			165					170					175		
Ala	Ala	Leu	Ile	Ala	Gly	Leu	Leu	Lys	Ile	Lys	Pro	Ile	Leu	Thr	Phe
		180						185					190		
Glu	Asp	Gly	Lys	Ile	Val	Leu	Phe	Glu	Lys	Ile	Arg	Ser	Thr	Lys	Lys
	195						200					205			
Ala	Phe	Ala	Arg	Ala	Glu	Lys	Ile	Ile	Gly	Glu	Arg	Asn	Ala	Gly	Ile
	210				215						220				
Glu	Ala	Pro	Val	Lys	Leu	Tyr	Val	Ile	His	Ala	Asn	Asn	Arg	Ile	Val
225					230					235				240	
Ala	Glu	Lys	Glu	Gln	Ala	Lys	Leu	Gln	Lys	Leu	Tyr	Pro	Asn	Ala	Glu
			245					250					255		
Ile	Glu	Ile	Gly	His	Phe	Gly	Pro	Val	Ile	Gly	Thr	His	Leu	Gly	Glu
		260						265					270		
Lys	Ala	Ile	Gly	Leu	Ala	Ile	Ser	Ala	Gln						
	275						280								

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Figure 14A

Pail

gagattatct	aaagaaaagt	aagcacaatt	cgagggtttca	atgttttttt	caaagggatg	60
atttttctaga	atgtcacaaag	aaaagatcat	tttatagtag	tgaaatagtt	gaggaatgtc	120
ttttcgttta	tctgtatcat	aaacagcaag	caattctttt	gctgtaacaa	ctaagccagt	180
ttcttccaat	acttcttttt	caatatatttc	tttaggagag	cagccaattt	cggcatagcc	240
accaggtaat	gaccattctt	tggtccgtaa	atcttcaact	aataaaaaac	gattctcttt	300
ttttatcaaa	ccgcgaacat	ctactttcgg	tggtggataa	ccttcttctt	tagttaagat	360
tttttctaag	tcgggcaaga	cagtcgcttc	gtgtccggtt	gcgctaataa	gttgtaacgt	420
aagttctcgt	agttcttggg	aacgttcttg	atcaaaaagca	tctttcccg	aaaaaagacc	480
agcatctgcc	aatgtctagca	accgcttata	agtgttcaga	taatccatat	acgcacgctc	540
ctcatagact	taatacgttt	agtttaacag	aaaaaaataa	agaaagggca	gatttagcga	600
gaaaaggcgt	cgttttaagg	aaataataaa	gaataaatga	ctaacttaca	tttttaact	660
acctatgcta	ttatttaata	aaaaagattg	ggtatacaat	aattttgtta	tgtaaacaaa	720
aaggaggttg	taaattgaaa	gaattttaca	ttataagggg	aaaaaatgca	gataaaaaaga	780
ctcaggcagc	acaagaagta	ttgtttaatc	ttccagaatg	gtttggcctt	gaaaaagaga	840
cccgaagta	tatcgatata	gctagcactt	tacctatgtg	ggtggcaaa	gatgtagaga	900
ataaaatact	cggttttata	aaccaagtaa	agatacagta	gaaatccatt		960
gtatggcagt	taaaaagcgg	tatcatcgca	aaggatatcg	caagttattg	atagaaagcg	1020
tggaacgta	ttctaaaaat	aactattttt	ttattcaagt	caaaacagtt	gacgaaggaa	1080
attattccgt	gtacgatcat	actattcggt	tttacgaatc	attgggtttt	aagcgccttg	1140
aggtttttcc	gacattatgg	gacgcttgga	atccttggtt	aatttttaatt	aaacagttga	1200
tttaatctac	aaaggagttt	tagtatgtca	gtatttatta	gagagtgtac	cgtcgcagac	1260
gtaccagaat	tagaggccat	ttgccaaag	acttttgcag	atacttatgg	agatggcgaa	1320
aacgaaaagg	atttacaggc	acattatgag	aggaaattta	gtccagcagt	tttagaaagc	1380
gaaatcttac	ataaagattc	gcaatatttc	tttgcttttt	ataataatga	acttgcaggt	1440
tatgtgaaat	taaatcacgg	tgatgctcag	attacctatc	aacatccaca	agcgttacia	1500
gttgagcgca	tttatattcg	taaatctttt	aagcgtttag	gcttaggcaa	acatttgatt	1560
acgaaagcaa	ttgaattagc	ggaagaagca	gaaaaagaga	cggtttggtt	aggtgtttgg	1620
gaacataatc	atccagcgca	aaaattttat	caatcattgg	gcttcgtcaa	aacagatgaa	1680
catgattttt	atatgggaaa	tgaacgccat	accgattata	caatgacgaa	acagttaaaa	1740
gagtcacggt	aaagcaaaaa	caaggaaacg	gacgcaatga	agccgacgat	tccttgtttt	1800
tttatcttaa	aattgtgaag	gagattttcc	ataatatatt	ttgaataatt	tactgaaatg	1860
ataggcattc	tcgtaaccaa	ccgtttttgc	cacttctttg	acacttaggg	aatcattttt	1920
cagcaattct	ttcgcatggg	tttaagcggg	ttgaattaaa	taattgattg	gccaacgcc	1980
tgtggccgct	ttaaagggtt	tcgacaaaata	agtcgggggtc	acatatagca	tttcagctaa	2040
ctgttccaaa	gtaattttct	cgtcatgggt	cgtttccaga	taataaatcg	tatgattgac	2100
taaatttcgt	tttctttttt	ccgttttcga	tagccgagtt	tcaattttat	tttcttgatc	2160
aactgctaag	cttcttaaaa	tatagaccaa	tagttcaata	act		2203

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Figure 14B

Pail
 Met Ser Val Phe Ile Arg Glu Cys Thr Val Ala Asp Val Pro Glu Leu
 1 5 10 15
 Glu Ala Ile Cys Gln Glu Thr Phe Ala Asp Thr Tyr Gly Asp Gly Glu
 20 25 30
 Asn Glu Lys Asp Leu Gln Ala His Tyr Glu Arg Lys Phe Ser Pro Ala
 35 40 45
 Val Leu Glu Ser Glu Ile Leu His Lys Asp Ser Gln Tyr Phe Phe Ala
 50 55 60
 Phe Tyr Asn Asn Glu Leu Ala Gly Tyr Val Lys Leu Asn His Gly Asp
 65 70 75 80
 Ala Gln Ile Thr Tyr Gln His Pro Gln Ala Leu Gln Val Glu Arg Ile
 85 90 95
 Tyr Ile Arg Lys Ser Phe Lys Arg Leu Gly Leu Gly Lys His Leu Ile
 100 105 110
 Thr Lys Ala Ile Glu Leu Ala Glu Glu Ala Glu Lys Glu Thr Val Trp
 115 120 125
 Leu Gly Val Trp Glu His Asn His Pro Ala Gln Lys Phe Tyr Gln Ser
 130 135 140
 Leu Gly Phe Val Lys Thr Asp Glu His Asp Phe Tyr Met Gly Asn Glu
 145 150 155 160
 Arg His Thr Asp Tyr Thr Met Thr Lys Gln Leu Lys Glu Ser Thr
 165 170 175

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Figure 15A

Enterococcal amino acid biosynthetic gene cluster

```

ccatgtagat ttaagaaaat ctatagtggc ttttatattg cttttttgta gggatttcac 60
tgtagatttt tcttaaaatt tactgtgaat atcctttttg tttggccaaa aattaggatt 120
tcagaaactt actaaaaaaa tttcgtaaag gagcacacag g atg aaa gaa ata act 176
                                     Met Lys Glu Ile Thr
                                     1       5

gga gcc act cgt tta gct ggg cta ttc gcg aaa ccc agc caa cac agt 224
Gly Ala Thr Arg Leu Ala Gly Leu Phe Ala Lys Pro Ser Gln His Ser
                        10                        15                        20

att tca ccg ttg att cat aat aca gca ttt caa aat tta gga gtt gat 272
Ile Ser Pro Leu Ile His Asn Thr Ala Phe Gln Asn Leu Gly Val Asp
                        25                        30                        35

gct cgg tat ctg gcg ttt gac gtt gga caa gag aca ttg cca caa gca 320
Ala Arg Tyr Leu Ala Phe Asp Val Gly Gln Glu Thr Leu Pro Gln Ala
                        40                        45                        50

att gaa gcg att cga acg ttt cac atg tta ggg gcc aac tta tca atg 368
Ile Glu Ala Ile Arg Thr Phe His Met Leu Gly Ala Asn Leu Ser Met
                        55                        60                        65

ccc aat aaa gtg gcg gct gta agt tat atg gat gaa cta agt cct acc 416
Pro Asn Lys Val Ala Ala Val Ser Tyr Met Asp Glu Leu Ser Pro Thr
                        70                        75                        80                        85

gct caa ctg gtt ggc gca att aat acg att gtc aac aaa gat gga aaa 464
Ala Gln Leu Val Gly Ala Ile Asn Thr Ile Val Asn Lys Asp Gly Lys
                        90                        95                        100

ctt tac gga gac agc acg gat ggt act ggt ttt atg tgg agt ttg aaa 512
Leu Tyr Gly Asp Ser Thr Asp Gly Thr Gly Phe Met Trp Ser Leu Lys
                        105                        110                        115

gag aaa aag gtt gac gtt ttt cag aat aaa atg acc atc tta gga aca 560
Glu Lys Lys Val Asp Val Phe Gln Asn Lys Met Thr Ile Leu Gly Thr
                        120                        125                        130

ggt ggt gca gcc tta tca atc att gcc caa gct gct tta gat ggc gtg 608
Gly Gly Ala Ala Leu Ser Ile Ile Ala Gln Ala Ala Leu Asp Gly Val
                        135                        140                        145

aaa gaa atc gcc gtt tac aac agg aaa agc gcg ggc ttt aac gac agt 656
Lys Glu Ile Ala Val Tyr Asn Arg Lys Ser Ala Gly Phe Asn Asp Ser
                        150                        155                        160                        165

caa aaa aaa ctg gca aat ttc act gaa cga acc aac tgt gta att cat 704
Gln Lys Lys Leu Ala Asn Phe Thr Glu Arg Thr Asn Cys Val Ile His
                        170                        175                        180

tta aac gat tta gcg gat act gaa aaa cta gca aaa gat gtt gct gaa 752
Leu Asn Asp Leu Ala Asp Thr Glu Lys Leu Ala Lys Asp Val Ala Glu
                        185                        190                        195

agc gtc ttg tta gtt aat gca acg agt gtg ggt atg cat cca cat gcg 800
Ser Val Leu Leu Val Asn Ala Thr Ser Val Gly Met His Pro His Ala
                        200                        205                        210

cat agt agt cct ata gaa aat tat gca atg att caa ccg aag tta ttt 848

```

His	Ser	Ser	Pro	Ile	Glu	Asn	Tyr	Ala	Met	Ile	Gln	Pro	Lys	Leu	Phe	
215						220					225					
gtg	tat	gat	gct	att	tat	aat	ccc	aga	gaa	aca	cag	tta	tta	aaa	gaa	896
Val	Tyr	Asp	Ala	Ile	Tyr	Asn	Pro	Arg	Glu	Thr	Gln	Leu	Leu	Lys	Glu	
230					235					240					245	
gcc	cgt	tta	cgt	ggt	gca	gaa	aca	agc	aac	ggc	ttg	gac	atg	cta	ctt	944
Ala	Arg	Leu	Arg	Gly	Ala	Glu	Thr	Ser	Asn	Gly	Leu	Asp	Met	Leu	Leu	
				250					255					260		
tat	caa	ggc	gct	gct	gct	ttt	gaa	caa	tgg	aca	gga	caa	aaa	atg	cct	992
Tyr	Gln	Gly	Ala	Ala	Ala	Phe	Glu	Gln	Trp	Thr	Gly	Gln	Lys	Met	Pro	
			265					270						275		
gta	tca	gtc	gta	aaa	cgt	aaa	att	gaa	aat	aga	taa	aaagagcgcc				1038
Val	Ser	Val	Val	Lys	Arg	Lys	Ile	Glu	Asn	Arg	*					
			280				285									
gtttaaaggc	atgaggagag	aatata	atg	atc	gta	att	atg	aaa	gaa	aat	gca					1091
			Met	Ile	Val	Ile	Met	Lys	Glu	Asn	Ala					
							290				295					
acc	gaa	aag	caa	atg	aaa	caa	gtc	att	gat	tta	gta	aca	ggg	gca	ggc	1139
Thr	Glu	Lys	Gln	Met	Lys	Gln	Val	Ile	Asp	Leu	Val	Thr	Gly	Ala	Gly	
			300				305					310				
tta	act	act	caa	aca	agt	caa	gat	aat	gga	aaa	aca	gtg	ata	ggc	ttg	1187
Leu	Thr	Thr	Gln	Thr	Ser	Gln	Asp	Asn	Gly	Lys	Thr	Val	Ile	Gly	Leu	
			315			320					325					
att	ggg	gat	aca	gaa	aaa	tta	gtt	gaa	gca	gag	tta	aca	gca	tta	gaa	1235
Ile	Gly	Asp	Thr	Glu	Lys	Leu	Val	Glu	Ala	Glu	Leu	Thr	Ala	Leu	Glu	
330					335					340					345	
ggc	gtg	gag	aaa	agt	gtc	cgc	att	tcg	ttg	tct	tac	aaa	cta	acg	agt	1283
Gly	Val	Glu	Lys	Ser	Val	Arg	Ile	Ser	Leu	Ser	Tyr	Lys	Leu	Thr	Ser	
				350					355					360		
cgt	tta	ttt	cat	cca	gag	aat	aca	gtg	gtt	gat	gtg	aac	ggg	gtt	aaa	1331
Arg	Leu	Phe	His	Pro	Glu	Asn	Thr	Val	Val	Asp	Val	Asn	Gly	Val	Lys	
			365				370						375			
atc	ggg	gac	ggc	agt	atg	acc	atg	atg	gcg	ggc	cct	tgt	tca	atc	gaa	1379
Ile	Gly	Asp	Gly	Ser	Met	Thr	Met	Met	Ala	Gly	Pro	Cys	Ser	Ile	Glu	
			380				385					390				
agc	tta	gat	cag	att	cgc	gaa	tgt	gcg	cga	att	gct	aaa	gct	gga	ggg	1427
Ser	Leu	Asp	Gln	Ile	Arg	Glu	Cys	Ala	Arg	Ile	Ala	Lys	Ala	Gly	Gly	
			395			400					405					
gca	aca	att	tta	cga	ggg	ggg	gca	ttc	aaa	cct	aga	acg	tcg	cca	tac	1475
Ala	Thr	Ile	Leu	Arg	Gly	Gly	Ala	Phe	Lys	Pro	Arg	Thr	Ser	Pro	Tyr	
410					415					420					425	
gct	ttc	caa	gga	cta	gaa	gaa	gaa	gga	cta	aaa	tac	att	cgc	caa	gcg	1523
Ala	Phe	Gln	Gly	Leu	Glu	Glu	Glu	Gly	Leu	Lys	Tyr	Ile	Arg	Gln	Ala	
				430				435						440		
gct	gat	gaa	tta	gat	atg	caa	gtc	att	aca	gaa	gtg	atg	gat	gaa	gcg	1571
Ala	Asp	Glu	Leu	Asp	Met	Gln	Val	Ile	Thr	Glu	Val	Met	Asp	Glu	Ala	

Fig. 15A
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445	450	455	
aat tta gaa ctt gtc gca aaa tac agt gac att tta caa atc ggt gcg Asn Leu Glu Leu Val Ala Lys Tyr Ser Asp Ile Leu Gln Ile Gly Ala 460 465 470			1619
cgc aac atg caa aat ttc aag tta tta caa gcg gtt ggt aaa act gga Arg Asn Met Gln Asn Phe Lys Leu Leu Gln Ala Val Gly Lys Thr Gly 475 480 485			1667
aaa cct att ggc tta aaa cgc ggg att gct ggt acg att gat gaa tgg Lys Pro Ile Gly Leu Lys Arg Gly Ile Ala Gly Thr Ile Asp Glu Trp 490 495 500 505			1715
cta aac gca gct gaa tac att gct gcg caa gga aat ttc aat gtg atc Leu Asn Ala Ala Glu Tyr Ile Ala Ala Gln Gly Asn Phe Asn Val Ile 510 515 520			1763
ttc att gaa cgt ggg att cgt acg tac gaa acc gct acg cgc aat aca Phe Ile Glu Arg Gly Ile Arg Thr Tyr Glu Thr Ala Thr Arg Asn Thr 525 530 535			1811
ctt gat tta agt gcg gtg cct tta att aaa aaa tta agt cat ttt cca Leu Asp Leu Ser Ala Val Pro Leu Ile Lys Lys Leu Ser His Phe Pro 540 545 550			1859
att att gtt gat ccg agt cat ggt gtt ggt atc tgg gat tta gta ccg Ile Ile Val Asp Pro Ser His Gly Val Gly Ile Trp Asp Leu Val Pro 555 560 565			1907
cca atg gcc cga gca ggt gtt gct tca ggt gcg gac ggc ttg att gta Pro Met Ala Arg Ala Gly Val Ala Ser Gly Ala Asp Gly Leu Ile Val 570 575 580 585			1955
gaa att cat cca gat cca gcg aat gcg tgg tca gat ggc cca caa tcc Glu Ile His Pro Asp Pro Ala Asn Ala Trp Ser Asp Gly Pro Gln Ser 590 595 600			2003
ttg aat gaa aaa act tac cta cgt atg atg aaa gaa gtt cat atc atc Leu Asn Glu Lys Thr Tyr Leu Arg Met Met Lys Glu Val His Ile Ile 605 610 615			2051
gaa aaa gca atg aaa gaa att aat gct tta gaa gat tag taaagacaga Glu Lys Ala Met Lys Glu Ile Asn Ala Leu Glu Asp *			2100
ggagtagagg ac atg aaa tta acc gta acg tta cct aca cat tca tat gat Met Lys Leu Thr Val Thr Leu Pro Thr His Ser Tyr Asp 630 635 640			2151
tta acc atc gaa aca ggt gcc tta gat aaa att ggc acc tgg gta cgt Leu Thr Ile Glu Thr Gly Ala Leu Asp Lys Ile Gly Thr Trp Val Arg 645 650 655			2199
agc ctg tgg cag cca caa cgg gta gcg att att acc gat gaa acg gtg Ser Leu Trp Gln Pro Gln Arg Val Ala Ile Ile Thr Asp Glu Thr Val 660 665 670			2247
aat aaa tta tat ggc gca gct gtt gag aaa gaa ttg caa gct gct ggt Asn Lys Leu Tyr Gly Ala Ala Val Glu Lys Glu Leu Gln Ala Ala Gly 675 680 685 690			2295

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Fig. 15A
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ttt gaa aca tca ttg att gct gta gcg gca ggt gaa caa agt aag agc	2343
Phe Glu Thr Ser Leu Ile Ala Val Ala Ala Gly Glu Gln Ser Lys Ser	
695 700 705	
ctc gaa ata gct caa ctg ctt tat gat ttt tta gcg gaa cag caa ttg	2391
Leu Glu Ile Ala Gln Leu Leu Tyr Asp Phe Leu Ala Glu Gln Gln Leu	
710 715 720	
act cga agt gat ggt cta att gct tta ggt gga ggc gtt gtg gga gat	2439
Thr Arg Ser Asp Gly Leu Ile Ala Leu Gly Gly Gly Val Val Gly Asp	
725 730 735	
cta gct gga ttt gtc gct tca acc tat atg cgc ggt att cac ttt ttg	2487
Leu Ala Gly Phe Val Ala Ser Thr Tyr Met Arg Gly Ile His Phe Leu	
740 745 750	
caa gta cca aca acc tta ctg gca caa gta gat agt agc att gga ggt	2535
Gln Val Pro Thr Thr Leu Leu Ala Gln Val Asp Ser Ser Ile Gly Gly	
755 760 765 770	
aaa aca gcg gtt aat act aaa aaa gcc aaa aat ctt gtc ggt act ttt	2583
Lys Thr Ala Val Asn Thr Lys Lys Ala Lys Asn Leu Val Gly Thr Phe	
775 780 785	
gcc caa cca gat ggg gtt tta att gat cct aat aca ctt aaa aca tta	2631
Ala Gln Pro Asp Gly Val Leu Ile Asp Pro Asn Thr Leu Lys Thr Leu	
790 795 800	
gaa cct aga cgt gtg cgt gaa gga att gca gaa att gta aaa tca gca	2679
Glu Pro Arg Arg Val Arg Glu Gly Ile Ala Glu Ile Val Lys Ser Ala	
805 810 815	
gct atc gct gat gtt gaa ttg tgg cac cgt tta tcc tct ttg gaa aat	2727
Ala Ile Ala Asp Val Glu Leu Trp His Arg Leu Ser Ser Leu Glu Asn	
820 825 830	
gaa caa gat tta gtg gca cat gca gaa gaa att atc acg gcc tgt tgc	2775
Glu Gln Asp Leu Val Ala His Ala Glu Glu Ile Ile Thr Ala Cys Cys	
835 840 845 850	
aag att aaa cgt gat gtc gtc gaa gaa gat gaa tta gat ttg ggc tta	2823
Lys Ile Lys Arg Asp Val Val Glu Glu Asp Glu Leu Asp Leu Gly Leu	
855 860 865	
cgt ttg att ctg aat ttt ggg cat acg atc ggc cac gca tta gaa aat	2871
Arg Leu Ile Leu Asn Phe Gly His Thr Ile Gly His Ala Leu Glu Asn	
870 875 880	
aca gct ggt tac ggg gtg att gct cac ggt gaa ggc gtt tct tta gga	2919
Thr Ala Gly Tyr Gly Val Ile Ala His Gly Glu Gly Val Ser Leu Gly	
885 890 895	
atg att caa ata act caa gtc gca gaa caa caa ggc ctt tcc cca ctt	2967
Met Ile Gln Ile Thr Gln Val Ala Glu Gln Gln Gly Leu Ser Pro Leu	
900 905 910	
ggg act acc caa gag ttg gtc acc atg cta gaa aag ttc cat tta cca	3015
Gly Thr Thr Gln Glu Leu Val Thr Met Leu Glu Lys Phe His Leu Pro	
915 920 925 930	

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gta acc aca gat cgt tgg tca gaa gaa cgt ctc tat caa gca att aca	3063
Val Thr Thr Asp Arg Trp Ser Glu Glu Arg Leu Tyr Gln Ala Ile Thr	
935 940 945	
cat gat aaa aaa aca cgt ggg gga cag att aaa atc att gtc tta gaa	3111
His Asp Lys Lys Thr Arg Gly Gly Gln Ile Lys Ile Ile Val Leu Glu	
950 955 960	
aaa att ggt caa gcg aaa att gtc tct tta cca acg gaa gaa att cga	3159
Lys Ile Gly Gln Ala Lys Ile Val Ser Leu Pro Thr Glu Glu Ile Arg	
965 970 975	
gca ttt tta aac aga gaa gga gga att taa g atg cgc ttt att aca gca	3208
Ala Phe Leu Asn Arg Glu Gly Gly Ile * Met Arg Phe Ile Thr Ala	
980 985 990	
ggc gaa tca cat gga cct gaa tta act gct att att gaa ggc tta cca	3256
Gly Glu Ser His Gly Pro Glu Leu Thr Ala Ile Ile Glu Gly Leu Pro	
995 1000 1005	
gcc gcc ttg cct tta agt agc gaa gag att aac cga gaa tta gca aga	3304
Ala Gly Leu Pro Leu Ser Ser Glu Glu Ile Asn Arg Glu Leu Ala Arg	
1010 1015 1020 1025	
cgt caa ggc ggt tac ggt cgt ggg gga cgg atg aaa att gaa aaa gac	3352
Arg Gln Gly Gly Tyr Gly Arg Gly Gly Arg Met Lys Ile Glu Lys Asp	
1030 1035 1040	
caa gta cgt att act tcg ggt att cgg cat ggt aaa aca ctt ggc tca	3400
Gln Val Arg Ile Thr Ser Gly Ile Arg His Gly Lys Thr Leu Gly Ser	
1045 1050 1055	
cca gta acg ttg att gtc gaa aac aaa gac tgg aaa aat tgg acc tcc	3448
Pro Val Thr Leu Ile Val Glu Asn Lys Asp Trp Lys Asn Trp Thr Ser	
1060 1065 1070	
gtg atg tca gta gag cca gtt cct gaa aaa caa aag aaa atc cgc cgc	3496
Val Met Ser Val Glu Pro Val Pro Glu Lys Gln Lys Lys Ile Arg Arg	
1075 1080 1085	
gtc agc aaa cca cgt cca gga cat gct gat tta gtc ggt ggc atg aaa	3544
Val Ser Lys Pro Arg Pro Gly His Ala Asp Leu Val Gly Gly Met Lys	
1090 1095 1100 1105	
tat caa cat gat gat tta cgg aat gtt tta gaa cgg tct tcg gca cga	3592
Tyr Gln His Asp Asp Leu Arg Asn Val Leu Glu Arg Ser Ser Ala Arg	
1110 1115 1120	
gaa aca acg atg cgt gtg gcg att ggt gcg gtt gct aaa aaa ctc tta	3640
Glu Thr Thr Met Arg Val Ala Ile Gly Ala Val Ala Lys Lys Leu Leu	
1125 1130 1135	
gct gaa ctg gat atc caa gtc gct ggg cat gtc gcg gta tta ggt ggg	3688
Ala Glu Leu Asp Ile Gln Val Ala Gly His Val Ala Val Leu Gly Gly	
1140 1145 1150	
att gaa gct acg atc cct gaa aat tta acg att cgt gaa att caa gaa	3736
Ile Glu Ala Thr Ile Pro Gln Asn Leu Thr Ile Arg Glu Ile Gln Glu	
1155 1160 1165	
cga tct gaa caa tct gcc gtt cgc gta tta gat cct tcc gta gaa gaa	3784

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Arg Ser Glu Gln Ser Ala Val Arg Val Leu Asp Pro Ser Val Glu Glu	
1170 1175 1180 1185	
aaa atg aaa gaa cta att gac caa acc aag aaa aat ggc gat aca att	3832
Lys Met Lys Glu Leu Ile Asp Gln Thr Lys Lys Asn Gly Asp Thr Ile	
1190 1195 1200	
ggg ggt gta gta gaa gta ctt gtg ggt ggc gtt cca gct ggc tta ggt	3880
Gly Gly Val Val Glu Val Leu Val Gly Gly Val Pro Ala Gly Leu Gly	
1205 1210 1215	
agc tat gtc caa tgg gat cgt aaa cta gat gcc aaa att gcg caa gca	3928
Ser Tyr Val Gln Trp Asp Arg Lys Leu Asp Ala Lys Ile Ala Gln Ala	
1220 1225 1230	
gtt gta agc atc aac gct ttt aca ggt gct gag ttt ggc att gga ttt	3976
Val Val Ser Ile Asn Ala Phe Thr Gly Ala Glu Phe Gly Ile Gly Phe	
1235 1240 1245	
gaa atg gca caa cgc cct ggt agt caa ctg atg gac gag att gtt tgg	4024
Glu Met Ala Gln Arg Pro Gly Ser Gln Leu Met Asp Glu Ile Val Trp	
1250 1255 1260 1265	
gac gaa agt act ggt tat acc aga act tcc aac aat tta ggc ggt ttt	4072
Asp Glu Ser Thr Gly Tyr Thr Arg Thr Ser Asn Asn Leu Gly Gly Phe	
1270 1275 1280	
gaa gga gga atg acc aac gga atg cca atc atc gtt cgt ggt gtc atg	4120
Glu Gly Gly Met Thr Asn Gly Met Pro Ile Ile Val Arg Gly Val Met	
1285 1290 1295	
aaa cct att cca acc ctt tat aaa cca tta caa agc gtg aat att gat	4168
Lys Pro Ile Pro Thr Leu Tyr Lys Pro Leu Gln Ser Val Asn Ile Asp	
1300 1305 1310	
aca aaa gag cct tat aag gcc agt gtt gag cgc tct gat agc acg gcg	4216
Thr Lys Glu Pro Tyr Lys Ala Ser Val Glu Arg Ser Asp Ser Thr Ala	
1315 1320 1325	
gta ccg gcc gct agc gtt gtt tgt gaa gcc gtt gtt gca acg gaa gta	4264
Val Pro Ala Ala Ser Val Val Cys Glu Ala Val Val Ala Thr Glu Val	
1330 1335 1340 1345	
gca aag gct atg ctc gaa aaa ttt gat agt gac tca ttt gaa caa atg	4312
Ala Lys Ala Met Leu Glu Lys Phe Asp Ser Asp Ser Phe Glu Gln Met	
1350 1355 1360	
aaa gaa gca gtg aaa cgt tat cgt cta tat act caa aac ttt taa	4357
Lys Glu Ala Val Lys Arg Tyr Arg Leu Tyr Thr Gln Asn Phe	
1365 1370 1375	
tggaagaaag tcgcaagtat atggagggaa aaa atg aag aaa cgt att tta atc	4411
Met Lys Lys Arg Ile Leu Ile	
1380	
gta gga tta ggg cta atc ggg agt tca ctg gct ttg tgt atc aaa aaa	4459
Val Gly Leu Gly Leu Ile Gly Ser Ser Leu Ala Leu Cys Ile Lys Lys	
1385 1390 1395	
ggg cat cca aac agt gag att atc ggt ttc gat aat caa gcg gag gca	4507
Gly His Pro Asn Ser Glu Ile Ile Gly Phe Asp Asn Gln Ala Glu Ala	

Fig. 15A
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1400	1405	1410	
act gaa ttt gct aag aaa acg ggt cta att gat gag ata gct gaa tct Thr Glu Phe Ala Lys Lys Thr Gly Leu Ile Asp Glu Ile Ala Glu Ser 1415 1420 1425 1430			4555
tta aca agt ggg gca aga cga gca gag att att ttt ctt tgt tcc cca Leu Thr Ser Gly Ala Arg Arg Ala Glu Ile Ile Phe Leu Cys Ser Pro 1435 1440 1445			4603
gtt aaa gca act tta gta caa cta gaa gaa tta aac caa tta tca cta Val Lys Ala Thr Leu Val Gln Leu Glu Glu Leu Asn Gln Leu Ser Leu 1450 1455 1460			4651
gaa act gct ctg atc aca gat gtg ggt agt acc aag gtg gaa att aat Glu Thr Ala Leu Ile Thr Asp Val Gly Ser Thr Lys Val Glu Ile Asn 1465 1470 1475			4699
cag tta gca aca aag ctt aac atg aaa aat ttt att ggt ggt cat cca Gln Leu Ala Thr Lys Leu Asn Met Lys Asn Phe Ile Gly Gly His Pro 1480 1485 1490			4747
atg gct ggt tca cat aaa tcc ggc gta aca gcc gct gat gaa cgt ttg Met Ala Gly Ser His Lys Ser Gly Val Thr Ala Ala Asp Glu Arg Leu 1495 1500 1505 1510			4795
ttt gaa aat gcc tac tat att ttt acc gat gac cat ggc gaa aaa aac Phe Glu Asn Ala Tyr Tyr Ile Phe Thr Asp Asp His Gly Glu Lys Asn 1515 1520 1525			4843
aaa cag att cag gag tta caa acg tta cta aaa gga acg cat gcg aag Lys Gln Ile Gln Glu Leu Gln Thr Leu Leu Lys Gly Thr His Ala Lys 1530 1535 1540			4891
ttt att acg atg cct gca cag gaa cat gat gaa att act ggt gct cta Phe Ile Thr Met Pro Ala Gln Glu His Asp Glu Ile Thr Gly Ala Leu 1545 1550 1555			4939
agt cac ttg cca cat att gtt gcc gca gcg tta gtg aac gaa agt cag Ser His Leu Pro His Ile Val Ala Ala Ala Leu Val Asn Glu Ser Gln 1560 1565 1570			4987
caa ctg aat acc act tac cct aga gcg cag cag cta gcg gct gga gga Gln Leu Asn Thr Thr Pro Arg Ala Gln Gln Leu Ala Ala Gly Gly 1575 1580 1585 1590			5035
ttc aga gat att act cga att gct tcc tct gat gca acg atg tgg acg Phe Arg Asp Ile Thr Arg Ile Ala Ser Ser Asp Ala Thr Met Trp Thr 1595 1600 1605			5083
gat att tta tta agc aat cgc tta gta tta ttg gac tta cta gaa aat Asp Ile Leu Leu Ser Asn Arg Leu Val Leu Leu Asp Leu Leu Glu Asn 1610 1615 1620			5131
tgg caa aaa gag atg act act gtt tgc caa tgg tta aca gaa aaa aat Trp Gln Lys Glu Met Thr Thr Val Cys Gln Trp Leu Thr Glu Lys Asn 1625 1630 1635			5179
gcc cca gct att cgt aat ttt ttt gat aag gcc aaa gaa aca cgt gct Ala Pro Ala Ile Arg Asn Phe Phe Asp Lys Ala Lys Glu Thr Arg Ala 1640 1645 1650			5227

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caa ttg cct att cat aaa gaa ggc gca atc cca gct ttc tat gat ctg	5275
Gln Leu Pro Ile His Lys Glu Gly Ala Ile Pro Ala Phe Tyr Asp Leu	
1655 1660 1665 1670	
ttt gtt gat gta cca gat caa cca gga atc att gct gaa att acg caa	5323
Phe Val Asp Val Pro Asp Gln Pro Gly Ile Ile Ala Glu Ile Thr Gln	
1675 1680 1685	
att tta ggc gaa gcg gac ctt tct ctt aca aat att aaa att tta gaa	5371
Ile Leu Gly Glu Ala Asp Leu Ser Leu Thr Asn Ile Lys Ile Leu Glu	
1690 1695 1700	
acg aga gaa gaa atc tat ggg att ctt caa ttg tct ttt aaa aat caa	5419
Thr Arg Glu Glu Ile Tyr Gly Ile Leu Gln Leu Ser Phe Lys Asn Gln	
1705 1710 1715	
cca gac tgc caa gct gca aaa caa att tta tct aaa aaa acg aac tat	5467
Pro Asp Cys Gln Ala Ala Lys Gln Ile Leu Ser Lys Lys Thr Asn Tyr	
1720 1725 1730	
acg tgt tac gaa aaa taa gaggtg atg agg gtg caa cta cgt aca aat	5515
Thr Cys Tyr Glu Lys * Met Arg Val Gln Leu Arg Thr Asn	
1735 1740 1745	
gtg aag cat tta caa ggg act ctg atg gtt cct agc gac aaa tcg att	5563
Val Lys His Leu Gln Gly Thr Leu Met Val Pro Ser Asp Lys Ser Ile	
1750 1755 1760	
tcc cat aga agt att atg ttt gga gcg att tct tct gga aaa acg acg	5611
Ser His Arg Ser Ile Met Phe Gly Ala Ile Ser Ser Gly Lys Thr Thr	
1765 1770 1775	
att aca aat ttt cta aga ggc gaa gat tgt tta agt acc tta gcg gcg	5659
Ile Thr Asn Phe Leu Arg Gly Glu Asp Cys Leu Ser Thr Leu Ala Ala	
1780 1785 1790 1795	
ttt cgt tct tta ggt gtg aac att gaa gat gac ggg acg aca atc acc	5707
Phe Arg Ser Leu Gly Val Asn Ile Glu Asp Asp Gly Thr Thr Ile Thr	
1800 1805 1810	
gtt gag ggg cga gga ttt gca ggc tta aaa aag gcg aag aat aca att	5755
Val Glu Gly Arg Gly Phe Ala Gly Leu Lys Lys Ala Lys Asn Thr Ile	
1815 1820 1825	
gat gtt gga aat tca ggg aca aca att cgt ctg atg ctg ggc att tta	5803
Asp Val Gly Asn Ser Gly Thr Thr Ile Arg Leu Met Leu Gly Ile Leu	
1830 1835 1840	
gct ggc tgt ccc ttt gaa acg cgc cta gct ggt gat gcg tct att gcc	5851
Ala Gly Cys Pro Phe Glu Thr Arg Leu Ala Gly Asp Ala Ser Ile Ala	
1845 1850 1855	
aaa cga cca atg aat cgt gta atg ctt cct tta aac caa atg gga gcg	5899
Lys Arg Pro Met Asn Arg Val Met Leu Pro Leu Asn Gln Met Gly Ala	
1860 1865 1870 1875	
gaa tgt caa ggg gtt cag caa acg gag ttt ccg cca att tct att cgc	5947
Glu Cys Gln Gly Val Gln Gln Thr Glu Phe Pro Pro Ile Ser Ile Arg	
1880 1885 1890	

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ggg act caa aat ttg caa ccg att gac tac aca atg cct gtt gca agt	5995
Gly Thr Gln Asn Leu Gln Pro Ile Asp Tyr Thr Met Pro Val Ala Ser	
1895 1900 1905	
gct caa gtt aaa tcg gct att tta ttc gcc gct ttg caa gcc gag ggc	6043
Ala Gln Val Lys Ser Ala Ile Leu Phe Ala Ala Leu Gln Ala Glu Gly	
1910 1915 1920	
act tct gta gtg gtt gag aaa gaa aag aca cgt gat cat aca gaa gag	6091
Thr Ser Val Val Val Glu Lys Glu Lys Thr Arg Asp His Thr Glu Glu	
1925 1930 1935	
atg att cga caa ttt ggt ggg aca ctt gaa gta gac ggt aaa aaa att	6139
Met Ile Arg Gln Phe Gly Gly Thr Leu Glu Val Asp Gly Lys Lys Ile	
1940 1945 1950 1955	
atg tta act gga ccg caa caa tta aca ggt caa aat gtg gta gtt cct	6187
Met Leu Thr Gly Pro Gln Gln Leu Thr Gly Gln Asn Val Val Val Pro	
1960 1965 1970	
ggt gat atc tct tct gca gct ttc ttt tta gtt gcg ggt tta gta gtc	6235
Gly Asp Ile Ser Ser Ala Ala Phe Phe Leu Val Ala Gly Leu Val Val	
1975 1980 1985	
cca gat agc gag ata ctt ctg aaa aat gtt ggc tta aat caa acg cgg	6283
Pro Asp Ser Glu Ile Leu Leu Lys Asn Val Gly Leu Asn Gln Thr Arg	
1990 1995 2000	
aca ggt att tta gat gtg att aaa aac atg ggc ggt tcc gtc act att	6331
Thr Gly Ile Leu Asp Val Ile Lys Asn Met Gly Gly Ser Val Thr Ile	
2005 2010 2015	
tta aat gaa gat gag gcc aat cat tct ggc gat tta ctt gta aaa acg	6379
Leu Asn Glu Asp Glu Ala Asn His Ser Gly Asp Leu Leu Val Lys Thr	
2020 2025 2030 2035	
agt caa tta aca gct aca gag att ggt ggc gct att atc cca cgt tta	6427
Ser Gln Leu Thr Ala Thr Glu Ile Gly Gly Ala Ile Ile Pro Arg Leu	
2040 2045 2050	
att gat gag tta ccg att att gct ttg tta gct act cag gct act ggc	6475
Ile Asp Glu Leu Pro Ile Ile Ala Leu Leu Ala Thr Gln Ala Thr Gly	
2055 2060 2065	
acg aca atc att cga gat gca gaa gaa ttg aaa gtc aaa gaa acc aat	6523
Thr Thr Ile Ile Arg Asp Ala Glu Glu Leu Lys Val Lys Glu Thr Asn	
2070 2075 2080	
cgg att gat gca gta gcg aaa gaa tta aca att tta ggc gcc gac atc	6571
Arg Ile Asp Ala Val Ala Lys Glu Leu Thr Ile Leu Gly Ala Asp Ile	
2085 2090 2095	
acg cct act gat gat ggc tta att ata cat gga cca act tct tta cat	6619
Thr Pro Thr Asp Asp Gly Leu Ile Ile His Gly Pro Thr Ser Leu His	
2100 2105 2110 2115	
ggt gga aga gtt acc agt tat ggg gat cat cgt atc ggg atg atg tta	6667
Gly Gly Arg Val Thr Ser Tyr Gly Asp His Arg Ile Gly Met Met Leu	
2120 2125 2130	
caa att gct gca tta ctt gta aaa gaa ggc act gtt gaa tta gat aag	6715

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Gln Ile Ala Ala Leu Leu Val Lys Glu Gly Thr Val Glu Leu Asp Lys	
2135	2145
gct gaa gca gtt tca gtt tct tat cca gca ttt ttt gac gac tta gaa	6763
Ala Glu Ala Val Ser Val Ser Tyr Pro Ala Phe Phe Asp Asp Leu Glu	
2150	2160
cgt tta agt tgt taa cgaaggagga taacga acc atg gaa agc att gtt tta	6815
Arg Leu Ser Cys *	Thr Met Glu Ser Ile Val Leu
2165	2170
att ggt ttc atg ggt gcg ggt aaa aca act atc ggc caa agt ttg gcc	6863
Ile Gly Phe Met Gly Ala Gly Lys Thr Thr Ile Gly Gln Ser Leu Ala	
2175	2190
aat aaa ctg aag atg cct cat ctt gat tta gat aca gcg tta att gaa	6911
Asn Lys Leu Lys Met Pro His Leu Asp Leu Asp Thr Ala Leu Ile Glu	
2195	2205
aaa ata gga cgc tca att cct gac tat ttc gaa aaa tat ggt gaa gca	6959
Lys Ile Gly Arg Ser Ile Pro Asp Tyr Phe Glu Lys Tyr Gly Glu Ala	
2210	2220
gct ttc cga gaa cag gaa acc caa ctt tta aag gag ctg tca aaa aat	7007
Ala Phe Arg Glu Gln Glu Thr Gln Leu Leu Lys Glu Leu Ser Lys Asn	
2225	2235
aca gcc gtc ctt tca act ggg ggc ggg att gtt gtc gga cca gaa aat	7055
Thr Ala Val Leu Ser Thr Gly Gly Gly Ile Val Val Gly Pro Glu Asn	
2240	2250
cgt agc tta tta aaa tct ttt cag caa gtg att tat tta cat gcg aca	7103
Arg Ser Leu Leu Lys Ser Phe Gln Gln Val Ile Tyr Leu His Ala Thr	
2255	2270
cca gaa gag ctg tta aaa aga atc aca gaa gat act gaa aac caa cgg	7151
Pro Glu Glu Leu Leu Lys Arg Ile Thr Glu Asp Thr Glu Asn Gln Arg	
2275	2285
ccc tta gct ata gaa cgt tct tca aaa gaa atc att act ttg ttt gag	7199
Pro Leu Ala Ile Glu Arg Ser Ser Lys Glu Ile Ile Thr Leu Phe Glu	
2290	2300
tct cgt aaa aat ttt tat gaa gaa tgt gcg aag atg aca att gat acg	7247
Ser Arg Lys Asn Phe Tyr Glu Glu Cys Ala Lys Met Thr Ile Asp Thr	
2305	2315
acc aat cgc tcg cca gaa gaa att atc aat gaa att ctg caa caa tta	7295
Thr Asn Arg Ser Pro Glu Glu Ile Ile Asn Glu Ile Leu Gln Gln Leu	
2320	2330
aag gag tag agaaacg atg aaa gtt ggt tat tta ggt ccg att ggt tcc	7344
Lys Glu *	Met Lys Val Gly Tyr Leu Gly Pro Ile Gly Ser
2335	2345
ttt acg tac agt gca acg ttg gct gct ttt cct gaa gct acg ttg atg	7392
Phe Thr Tyr Ser Ala Thr Leu Ala Ala Phe Pro Glu Ala Thr Leu Met	
2350	2360
ccg tac gca tcg att cca gct tgc ttg aaa gca att gaa cag caa gaa	7440
Pro Tyr Ala Ser Ile Pro Ala Cys Leu Lys Ala Ile Glu Gln Gln Glu	

Fig. 15A
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2365	2370	2375	
gtg gca tgg agc att atc cca ata gaa aac acg att gaa gga act gtt Val Ala Trp Ser Ile Ile Pro Ile Glu Asn Thr Ile Glu Gly Thr Val 2380 2385 2390 2395			7488
aac gca tcg ata gat tat ttg tat cat caa gcg cag tta cct gtc caa Asn Ala Ser Ile Asp Tyr Leu Tyr His Gln Ala Gln Leu Pro Val Gln 2400 2405 2410			7536
gca gag tta gtt tta ccg att caa caa caa tta atg gtg gca aaa gag Ala Glu Leu Val Leu Pro Ile Gln Gln Gln Leu Met Val Ala Lys Glu 2415 2420 2425			7584
aat caa gcg atc tgg caa caa agt cag aaa att tta tca cat ccg caa Asn Gln Ala Ile Trp Gln Gln Ser Gln Lys Ile Leu Ser His Pro Gln 2430 2435 2440			7632
gca tta gct caa tcg cag atg ttt cta gag aaa aac ttt cca gaa gcg Ala Leu Ala Gln Ser Gln Met Phe Leu Glu Lys Asn Phe Pro Glu Ala 2445 2450 2455			7680
att tta gaa gca aca cct tca aca gct tac gcc gcc aaa tac att gca Ile Leu Glu Ala Thr Pro Ser Thr Ala Tyr Ala Ala Lys Tyr Ile Ala 2460 2465 2470 2475			7728
gaa cat cca gaa tta cct ttt gca gct att gca cca aaa ctt tct gcg Glu His Pro Glu Leu Pro Phe Ala Ala Ile Ala Pro Lys Leu Ser Ala 2480 2485 2490			7776
gaa atg tat gat ttg acc att gtt gaa aaa aat ata caa gat tta tcg Glu Met Tyr Asp Leu Thr Ile Val Glu Lys Asn Ile Gln Asp Leu Ser 2495 2500 2505			7824
gta aat caa acc cga ttt tgg gtt ctt ggt tct gaa aat tta gcg att Val Asn Gln Thr Arg Phe Trp Val Leu Gly Ser Glu Asn Leu Ala Ile 2510 2515 2520			7872
tct ttc ccg cta tct gag aaa aaa ata aca ctg gcg att acg atg cca Ser Phe Pro Leu Ser Glu Lys Lys Ile Thr Leu Ala Ile Thr Met Pro 2525 2530 2535			7920
agt aat gtt cct ggc tct tta cac aaa gta tta agc gtg ttt agt tgg Ser Asn Val Pro Gly Ser Leu His Lys Val Leu Ser Val Phe Ser Trp 2540 2545 2550 2555			7968
cga ggg att aat ctt agc aaa ata gaa tcg cgg ccg ttg aaa aca aag Arg Gly Ile Asn Leu Ser Lys Ile Glu Ser Arg Pro Leu Lys Thr Lys 2560 2565 2570			8016
cta gga gag tac ttc ttt tta atg gac tta gtg aaa gat caa cca gaa Leu Gly Glu Tyr Phe Phe Leu Met Asp Leu Val Lys Asp Gln Pro Glu 2575 2580 2585			8064
aaa tta att gaa gca gcc tta aca gaa ctg gaa ctc att ggt gca gaa Lys Leu Ile Glu Ala Ala Leu Thr Glu Leu Glu Leu Ile Gly Ala Glu 2590 2595 2600			8112
ata aaa att tta ggg gat tac ccg atc tat gtt ttg tcc aca ctt taa Ile Lys Ile Leu Gly Asp Tyr Pro Ile Tyr Val Leu Ser Thr Leu * 2605 2610 2615			8160

agagttaaaa atgaaaatga agcttactta ttagataaag tgagtttcat tttttattaa 8220
attacatatt tgtaatagga atttcctgtg aaatgaggta tcctaagaaa ggtgataaaa 8280
cacagaggta aaggagtgc acgatgagtc gtgtagatcg ttataaacat attcatgaaa 8340
tcttttc 8347

Figure 15B

ORF1

atgaaagaaa	taactggagc	cactcgttta	gctgggctat	tcgcgaaacc	cagccaacac	60
agtatttcac	cgttgattca	taatacagca	tttcaaaatt	taggagttga	tgctcggtat	120
ctggcgtttg	acgttggaca	agagacattg	ccacaagcaa	ttgaagcgat	tcgaacgttt	180
cacatgttag	gggccaactt	atcaatgccc	aataaagtgg	cggctgtaag	ttatatggat	240
gaactaagtc	ctaccgctca	actgggtggc	gcaattaata	cgattgtcaa	caaagatgga	300
aaactttacg	gagacagcac	ggatgggtact	ggttttatgt	ggagtttgaa	agagaaaaag	360
gttgacgttt	ttcagaataa	aatgaccatc	ttaggaacag	gtggtgcagc	cttatcaatc	420
attgcccaag	ctgctttaga	tggcgtgaaa	gaaatcgccg	tttacaacag	gaaaagcgcg	480
ggctttaacg	acagtcaaaa	aaaactggca	aatttcactg	aacgaacca	ctgtgtaatt	540
catttaaacg	atttagcgga	tactgaaaaa	ctagcaaaaag	atgttgctga	aagcgtcttg	600
ttagttaatg	caacgagtgt	gggtatgcat	ccacatgcgc	atagtagtcc	tatagaaaat	660
tatgcaatga	ttcaaccgaa	gttattttgtg	tatgatgcta	tttataatcc	cagagaaaca	720
cagttattaa	aagaagcccg	tttacgtggg	gcagaaacaa	gcaacggcct	ggacatgcta	780
ctttatcaag	gcgctgctgc	ttttgaacaa	tggacaggac	aaaaaatgcc	tgtatcagtc	840
gtaaaacgta	aaattgaaaa	tagataa				867

Figure 15C

ORF1

Met	Lys	Glu	Ile	Thr	Gly	Ala	Thr	Arg	Leu	Ala	Gly	Leu	Phe	Ala	Lys	1	5	10	15
Pro	Ser	Gln	His	Ser	Ile	Ser	Pro	Leu	Ile	His	Asn	Thr	Ala	Phe	Gln	20	25	30	
Asn	Leu	Gly	Val	Asp	Ala	Arg	Tyr	Leu	Ala	Phe	Asp	Val	Gly	Gln	Glu	35	40	45	
Thr	Leu	Pro	Gln	Ala	Ile	Glu	Ala	Ile	Arg	Thr	Phe	His	Met	Leu	Gly	50	55	60	
Ala	Asn	Leu	Ser	Met	Pro	Asn	Lys	Val	Ala	Ala	Val	Ser	Tyr	Met	Asp	65	70	75	80
Glu	Leu	Ser	Pro	Thr	Ala	Gln	Leu	Val	Gly	Ala	Ile	Asn	Thr	Ile	Val	85	90	95	
Asn	Lys	Asp	Gly	Lys	Leu	Tyr	Gly	Asp	Ser	Thr	Asp	Gly	Thr	Gly	Phe	100	105	110	
Met	Trp	Ser	Leu	Lys	Glu	Lys	Lys	Val	Asp	Val	Phe	Gln	Asn	Lys	Met	115	120	125	
Thr	Ile	Leu	Gly	Thr	Gly	Gly	Ala	Ala	Leu	Ser	Ile	Ile	Ala	Gln	Ala	130	135	140	
Ala	Leu	Asp	Gly	Val	Lys	Glu	Ile	Ala	Val	Tyr	Asn	Arg	Lys	Ser	Ala	145	150	155	160
Gly	Phe	Asn	Asp	Ser	Gln	Lys	Lys	Leu	Ala	Asn	Phe	Thr	Glu	Arg	Thr	165	170	175	
Asn	Cys	Val	Ile	His	Leu	Asn	Asp	Leu	Ala	Asp	Thr	Glu	Lys	Leu	Ala	180	185	190	
Lys	Asp	Val	Ala	Glu	Ser	Val	Leu	Leu	Val	Asn	Ala	Thr	Ser	Val	Gly	195	200	205	
Met	His	Pro	His	Ala	His	Ser	Ser	Pro	Ile	Glu	Asn	Tyr	Ala	Met	Ile	210	215	220	
Gln	Pro	Lys	Leu	Phe	Val	Tyr	Asp	Ala	Ile	Tyr	Asn	Pro	Arg	Glu	Thr	225	230	235	240
Gln	Leu	Leu	Lys	Glu	Ala	Arg	Leu	Arg	Gly	Ala	Glu	Thr	Ser	Asn	Gly	245	250	255	
Leu	Asp	Met	Leu	Leu	Tyr	Gln	Gly	Ala	Ala	Ala	Phe	Glu	Gln	Trp	Thr	260	265	270	
Gly	Gln	Lys	Met	Pro	Val	Ser	Val	Val	Lys	Arg	Lys	Ile	Glu	Asn	Arg	275	280	285	

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Figure 15D

ORF2

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atgatcgtaa ttatgaaaga aaatgcaacc gaaaagcaaa tgaaacaagt cattgattta 60
gtaacagggtg caggcttaac tactcaaaca agtcaagata atggaaaaac agtgataggc 120
ttgattgggtg atacagaaaa attagttgaa gcagagttaa cagcattaga aggcgtggag 180
aaaagtgtcc gcatttcgtt gtcttacaaa ctaacgagtc gtttatttca tccagagaat 240
acagtgggtg atgtgaacgg tgttaaaatc ggtgacggca gtatgaccat gatggcgggc 300
ccttgttcaa tcgaaagctt agatcagatt cgcgaatgtg cgcgaattgc taaagctgga 360
ggtgcaacaa ttttacgagg tgggtgcattc aaacctagaa cgtcgccata cgctttccaa 420
ggactagaag aagaaggact aaaatacatt cgccaagcgg ctgatgaatt agatatgcaa 480
gtcattacag aagtgatgga tgaagcgaat ttagaacttg tcgcaaaaata cagtgcatt 540
ttacaaatcg gtgcgcgcaa catgcaaaat ttcaagttat tacaagcggg ttgtaaaact 600
ggaaaaccta ttggcttaaa acgcgggatt gctggtacga ttgatgaatg gctaaacgca 660
gctgaataca ttgctgcgca aggaaatttc aatgtgatct tcattgaacg tgggattcgt 720
acgtacgaaa ccgctacgcg caatacactt gatttaagtg cgggtgccttt aattaaaaaa 780
ttaagtcatt ttccaattat tgttgatccg agtcatgggtg ttggtatctg ggatttagta 840
ccgccaatgg cccgagcagg tgttgcttca ggtgcggacg gcttgattgt agaaattcat 900
ccagatccag cgaatgcgtg gtcagatggg ccacaatcct tgaatgaaaa aacttaccta 960
cgtatgatga aagaagttca tatcatcgaa aaagcaatga aagaaattaa tgcttttagaa 1020
gattag                                           1026

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Figure 15E

ORF2

Met	Ile	Val	Ile	Met	Lys	Glu	Asn	Ala	Thr	Glu	Lys	Gln	Met	Lys	Gln
1				5					10					15	
Val	Ile	Asp	Leu	Val	Thr	Gly	Ala	Gly	Leu	Thr	Thr	Gln	Thr	Ser	Gln
		20						25					30		
Asp	Asn	Gly	Lys	Thr	Val	Ile	Gly	Leu	Ile	Gly	Asp	Thr	Glu	Lys	Leu
	35						40					45			
Val	Glu	Ala	Glu	Leu	Thr	Ala	Leu	Glu	Gly	Val	Glu	Lys	Ser	Val	Arg
	50					55					60				
Ile	Ser	Leu	Ser	Tyr	Lys	Leu	Thr	Ser	Arg	Leu	Phe	His	Pro	Glu	Asn
65					70					75					80
Thr	Val	Val	Asp	Val	Asn	Gly	Val	Lys	Ile	Gly	Asp	Gly	Ser	Met	Thr
			85						90					95	
Met	Met	Ala	Gly	Pro	Cys	Ser	Ile	Glu	Ser	Leu	Asp	Gln	Ile	Arg	Glu
		100						105					110		
Cys	Ala	Arg	Ile	Ala	Lys	Ala	Gly	Gly	Ala	Thr	Ile	Leu	Arg	Gly	Gly
		115					120					125			
Ala	Phe	Lys	Pro	Arg	Thr	Ser	Pro	Tyr	Ala	Phe	Gln	Gly	Leu	Glu	Glu
	130				135						140				
Glu	Gly	Leu	Lys	Tyr	Ile	Arg	Gln	Ala	Ala	Asp	Glu	Leu	Asp	Met	Gln
145					150					155					160
Val	Ile	Thr	Glu	Val	Met	Asp	Glu	Ala	Asn	Leu	Glu	Leu	Val	Ala	Lys
			165						170					175	
Tyr	Ser	Asp	Ile	Leu	Gln	Ile	Gly	Ala	Arg	Asn	Met	Gln	Asn	Phe	Lys
		180						185					190		
Leu	Leu	Gln	Ala	Val	Gly	Lys	Thr	Gly	Lys	Pro	Ile	Gly	Leu	Lys	Arg
	195						200					205			
Gly	Ile	Ala	Gly	Thr	Ile	Asp	Glu	Trp	Leu	Asn	Ala	Ala	Glu	Tyr	Ile
	210				215						220				
Ala	Ala	Gln	Gly	Asn	Phe	Asn	Val	Ile	Phe	Ile	Glu	Arg	Gly	Ile	Arg
225					230					235					240
Thr	Tyr	Glu	Thr	Ala	Thr	Arg	Asn	Thr	Leu	Asp	Leu	Ser	Ala	Val	Pro
			245						250					255	
Leu	Ile	Lys	Lys	Leu	Ser	His	Phe	Pro	Ile	Ile	Val	Asp	Pro	Ser	His
		260						265					270		
Gly	Val	Gly	Ile	Trp	Asp	Leu	Val	Pro	Pro	Met	Ala	Arg	Ala	Gly	Val
	275					280						285			
Ala	Ser	Gly	Ala	Asp	Gly	Leu	Ile	Val	Glu	Ile	His	Pro	Asp	Pro	Ala
	290				295						300				
Asn	Ala	Trp	Ser	Asp	Gly	Pro	Gln	Ser	Leu	Asn	Glu	Lys	Thr	Tyr	Leu
305					310					315					320
Arg	Met	Met	Lys	Glu	Val	His	Ile	Ile	Glu	Lys	Ala	Met	Lys	Glu	Ile
			325						330					335	
Asn	Ala	Leu	Glu	Asp											
			340												

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Figure 15F

ORF3

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atgaaattaa ccgtaacgtt acctacacat tcatatgatt taaccatcga aacaggtgcc 60
ttagataaaa ttggcacctg ggtacgtagc ctgtggcagc cacaacgggt agcgattatt 120
accgatgaaa cgggtgaataa attatatggc gcagctgttg agaaagaatt gcaagctgct 180
ggttttgaaa catcattgat tgctgtagcg gcaggtgaac aaagtaagag cctcgaaata 240
gctcaactgc tttatgattt tttagcggaa cagcaattga ctggaagtga tgggtctaatt 300
gctttagggtg gaggcgttgt gggagatcta gctggatttg tcgcttcaac ctatatgcgc 360
ggtattcact ttttgcaagt accaacaacc ttactggcac aagtagatag tagcattgga 420
ggtaaaacag cggttaatac taaaaaagcc aaaaatcttg tcggtacttt tgcccaacca 480
gatgggggtt taattgatcc taatacactt aaaacattag aacctagacg tgtgcgtgaa 540
ggaattgcag aaattgtaaa atcagcagct atcgctgatg ttgaattgtg gcaccgttta 600
tcctcttttg aaaatgaaca agatttagtg gcacatgcag aagaaattat cacggcctgt 660
tgcaagatta aacgtgatgt cgtcgaagaa gatgaattag atttgggctt acgtttgatt 720
ctgaattttg ggcatacgat cggccacgca ttagaaaata cagctgggta cgggggtgatt 780
gctcacgggtg aaggcggttc tttaggaatg attcaaataa ctcaagtgcg agaacaacaa 840
gggctttccc cacttgggac tacccaagag ttggtcacca tgctagaaaa gttccattta 900
ccagtaacca cagatcgttg gtcagaagaa cgtctctatc aagcaattac acatgataaa 960
aaaacacgtg ggggacagat taaaatcatt gtcttagaaa aaattgggtca agcgaaaatt 1020
gtctctttac caacggaaga aattcgagca tttttaaaca gagaaggagg aatttaa 1077

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Figure 15G

ORF3

Met	Lys	Leu	Thr	Val	Thr	Leu	Pro	Thr	His	Ser	Tyr	Asp	Leu	Thr	Ile
1				5					10					15	
Glu	Thr	Gly	Ala	Leu	Asp	Lys	Ile	Gly	Thr	Trp	Val	Arg	Ser	Leu	Trp
			20					25				30			
Gln	Pro	Gln	Arg	Val	Ala	Ile	Ile	Thr	Asp	Glu	Thr	Val	Asn	Lys	Leu
		35				40						45			
Tyr	Gly	Ala	Ala	Val	Glu	Lys	Glu	Leu	Gln	Ala	Ala	Gly	Phe	Glu	Thr
	50					55					60				
Ser	Leu	Ile	Ala	Val	Ala	Ala	Gly	Glu	Gln	Ser	Lys	Ser	Leu	Glu	Ile
65					70				75					80	
Ala	Gln	Leu	Leu	Tyr	Asp	Phe	Leu	Ala	Glu	Gln	Gln	Leu	Thr	Arg	Ser
				85				90					95		
Asp	Gly	Leu	Ile	Ala	Leu	Gly	Gly	Gly	Val	Val	Gly	Asp	Leu	Ala	Gly
		100					105						110		
Phe	Val	Ala	Ser	Thr	Tyr	Met	Arg	Gly	Ile	His	Phe	Leu	Gln	Val	Pro
		115				120						125			
Thr	Thr	Leu	Leu	Ala	Gln	Val	Asp	Ser	Ser	Ile	Gly	Gly	Lys	Thr	Ala
	130				135						140				
Val	Asn	Thr	Lys	Lys	Ala	Lys	Asn	Leu	Val	Gly	Thr	Phe	Ala	Gln	Pro
145					150				155					160	
Asp	Gly	Val	Leu	Ile	Asp	Pro	Asn	Thr	Leu	Lys	Thr	Leu	Glu	Pro	Arg
			165					170					175		
Arg	Val	Arg	Glu	Gly	Ile	Ala	Glu	Ile	Val	Lys	Ser	Ala	Ala	Ile	Ala
			180				185						190		
Asp	Val	Glu	Leu	Trp	His	Arg	Leu	Ser	Ser	Leu	Glu	Asn	Glu	Gln	Asp
		195				200						205			
Leu	Val	Ala	His	Ala	Glu	Glu	Ile	Ile	Thr	Ala	Cys	Lys	Ile	Lys	
	210				215						220				
Arg	Asp	Val	Val	Glu	Glu	Asp	Glu	Leu	Asp	Leu	Gly	Leu	Arg	Leu	Ile
225					230				235					240	
Leu	Asn	Phe	Gly	His	Thr	Ile	Gly	His	Ala	Leu	Glu	Asn	Thr	Ala	Gly
			245					250					255		
Tyr	Gly	Val	Ile	Ala	His	Gly	Glu	Gly	Val	Ser	Leu	Gly	Met	Ile	Gln
		260					265						270		
Ile	Thr	Gln	Val	Ala	Glu	Gln	Gln	Gly	Leu	Ser	Pro	Leu	Gly	Thr	Thr
		275				280						285			
Gln	Glu	Leu	Val	Thr	Met	Leu	Glu	Lys	Phe	His	Leu	Pro	Val	Thr	Thr
	290					295					300				
Asp	Arg	Trp	Ser	Glu	Glu	Arg	Leu	Tyr	Gln	Ala	Ile	Thr	His	Asp	Lys
305					310					315				320	
Lys	Thr	Arg	Gly	Gly	Gln	Ile	Lys	Ile	Ile	Val	Leu	Glu	Lys	Ile	Gly
			325					330					335		
Gln	Ala	Lys	Ile	Val	Ser	Leu	Pro	Thr	Glu	Glu	Ile	Arg	Ala	Phe	Leu
			340					345					350		
Asn	Arg	Glu	Gly	Gly	Ile										
		355													

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Figure 15H

ORF4

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atgcgcttta ttacagcagg cgaatcacat ggacctgaat taactgctat tattgaaggc 60
ttaccagccg gcttgccctt aagtagcgaa gagattaacc gagaattagc aagacgtcaa 120
ggcggttacg gtcgtggggg acggatgaaa attgaaaaag accaagtacg tattacttcg 180
ggtattcggc atggtaaaac acttggtca ccagtaacgt tgattgtcga aaacaaagac 240
tgaaaaaatt ggacctcgt gatgtcagta gagccagttc ctgaaaaaca aaagaaaatc 300
cgccgcgtca gcaaaccacg tccaggacat gctgatttag tcggtggcat gaaatatcaa 360
catgatgatt tacggaatgt tttagaacgg tcttcggcac gagaaacaac gatgcgtgtg 420
gcgattggtg cggttgctaa aaaactctta gctgaactgg atatccaagt cgctgggcat 480
gtcgcggtat taggtgggat tgaagctacg atccctgaaa atttaacgat tcgtgaaatt 540
caagaacgat ctgaacaatc tgccgttcgc gtattagatc cttccgtaga agaaaaaatg 600
aaagaactaa ttgaccaaac caagaaaaat ggcgatacaa ttggtggggt agtagaagta 660
cttggtgggt gcgttccagc tggcttaggt agctatgtcc aatgggatcg taaactagat 720
gccaaaattg cgcaagcagt tgtaagcatc aacgctttta caggtgctga gtttggcatt 780
ggatttgaaa tggcacaacg ccctggtagt caactgatgg acgagattgt ttgggacgaa 840
agtactggtt ataccagaac ttccaacaat ttaggcggtt ttgaaggagg aatgaccaac 900
ggaatgccaa tcatcgttcg tgggtgcatg aaacctattc caacccttta taaaccatta 960
caaagcgtga atattgatac aaaagagcct tataaggcca gtgttgagcg ctctgatagc 1020
acggcggtag cggcgcgtag cggtgtttgt gaagccgttg ttgcaacgga agtagcaaag 1080
gctatgctcg aaaaatttga tagtgactca tttgaacaaa tgaaagaagc agtgaaacgt 1140
tatcgtctat atactcaaaa cttttaaa
1167

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Figure 15I

ORF4

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Met Arg Phe Ile Thr Ala Gly Glu Ser His Gly Pro Glu Leu Thr Ala
 1           5           10           15
Ile Ile Glu Gly Leu Pro Ala Gly Leu Pro Leu Ser Ser Glu Glu Ile
      20           25           30
Asn Arg Glu Leu Ala Arg Arg Gln Gly Gly Tyr Gly Arg Gly Gly Arg
 35           40           45
Met Lys Ile Glu Lys Asp Gln Val Arg Ile Thr Ser Gly Ile Arg His
 50           55           60
Gly Lys Thr Leu Gly Ser Pro Val Thr Leu Ile Val Glu Asn Lys Asp
 65           70           75           80
Trp Lys Asn Trp Thr Ser Val Met Ser Val Glu Pro Val Pro Glu Lys
      85           90           95
Gln Lys Lys Ile Arg Arg Val Ser Lys Pro Arg Pro Gly His Ala Asp
      100           105           110
Leu Val Gly Gly Met Lys Tyr Gln His Asp Asp Leu Arg Asn Val Leu
      115           120           125
Glu Arg Ser Ser Ala Arg Glu Thr Thr Met Arg Val Ala Ile Gly Ala
      130           135           140
Val Ala Lys Lys Leu Leu Ala Glu Leu Asp Ile Gln Val Ala Gly His
      145           150           155           160
Val Ala Val Leu Gly Gly Ile Glu Ala Thr Ile Pro Glu Asn Leu Thr
      165           170           175
Ile Arg Glu Ile Gln Glu Arg Ser Glu Gln Ser Ala Val Arg Val Leu
      180           185           190
Asp Pro Ser Val Glu Glu Lys Met Lys Glu Leu Ile Asp Gln Thr Lys
      195           200           205
Lys Asn Gly Asp Thr Ile Gly Gly Val Val Glu Val Leu Val Gly Gly
      210           215           220
Val Pro Ala Gly Leu Gly Ser Tyr Val Gln Trp Asp Arg Lys Leu Asp
      225           230           235           240
Ala Lys Ile Ala Gln Ala Val Val Ser Ile Asn Ala Phe Thr Gly Ala
      245           250           255
Glu Phe Gly Ile Gly Phe Glu Met Ala Gln Arg Pro Gly Ser Gln Leu
      260           265           270
Met Asp Glu Ile Val Trp Asp Glu Ser Thr Gly Tyr Thr Arg Thr Ser
      275           280           285
Asn Asn Leu Gly Gly Phe Glu Gly Gly Met Thr Asn Gly Met Pro Ile
      290           295           300
Ile Val Arg Gly Val Met Lys Pro Ile Pro Thr Leu Tyr Lys Pro Leu
      305           310           315           320
Gln Ser Val Asn Ile Asp Thr Lys Glu Pro Tyr Lys Ala Ser Val Glu
      325           330           335
Arg Ser Asp Ser Thr Ala Val Pro Ala Ala Ser Val Val Cys Glu Ala
      340           345           350
Val Val Ala Thr Glu Val Ala Lys Ala Met Leu Glu Lys Phe Asp Ser
      355           360           365
Asp Ser Phe Glu Gln Met Lys Glu Ala Val Lys Arg Tyr Arg Leu Tyr
      370           375           380
Thr Gln Asn Phe
385

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Figure 15J

ORF5

atgaagaaac	gtattttaat	cgtaggatta	gggctaatacg	ggagttcact	ggctttgtgt	60
atcaaaaaaag	ggcatccaaa	cagtgagatt	atcggtttcg	ataatcaagc	ggaggcaact	120
gaatttgcta	agaaaacggg	tctaattgat	gagatagctg	aatctttaac	aagtggggca	180
agacgagcag	agattatfff	tctttgttcc	ccagttaaag	caactttagt	acaactagaa	240
gaattaaacc	aattatcact	agaaactgct	ctgatcacag	atgtgggtag	taccaaggtg	300
gaaattaatc	agttagcaac	aaagcttaac	atgaaaaatt	ttattggtgg	tcatccaatg	360
gctggttcac	ataaatccgg	cgtaacagcc	gctgatgaac	gtttgtttga	aatgcctac	420
tatattttta	ccgatgacca	tggcgaaaaa	aacaaacaga	ttcaggagtt	acaaacgtta	480
ctaaaaaggaa	cgcatgcgaa	gtttattacg	atgcctgcac	aggaacatga	tgaaattact	540
ggtgctctaa	gtcacttgcc	acatattggt	gccgcagcgt	tagtgaacga	aagtcagcaa	600
ctgaatacca	cttaccctag	agcgcagcag	ctagcggctg	gaggattcag	agatattact	660
cgaattgctt	cctctgatgc	aacgatgtgg	acggatattt	tattaagcaa	tcgcttagta	720
ttattggact	tactagaaaa	ttggcaaaaa	gagatgacta	ctgtttgcc	atggttaaca	780
gaaaaaaatg	ccccagctat	tcgtaatttt	tttgataagg	ccaaagaaac	acgtgctcaa	840
ttgcctattc	ataaagaagg	cgcaatccca	gctttctatg	atctgtttgt	tgatgtacca	900
gatcaaccag	gaatcattgc	tgaaattacg	caaatttttag	gcgaagcgga	cctttctctt	960
acaaatatta	aaattttaga	aacgagagaa	gaaatctatg	ggattcttca	attgtctttt	1020
aaaaatcaac	cagactgcc	agctgcaaaa	caaattttat	ctaaaaaaac	gaactatacg	1080
tgttacgaaa	aataa					1095

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Figure 15K

ORF5

Met	Lys	Lys	Arg	Ile	Leu	Ile	Val	Gly	Leu	Gly	Leu	Ile	Gly	Ser	Ser	1	5	10	15
Leu	Ala	Leu	Cys	Ile	Lys	Lys	Gly	His	Pro	Asn	Ser	Glu	Ile	Ile	Gly	20	25	30	
Phe	Asp	Asn	Gln	Ala	Glu	Ala	Thr	Glu	Phe	Ala	Lys	Lys	Thr	Gly	Leu	35	40	45	
Ile	Asp	Glu	Ile	Ala	Glu	Ser	Leu	Thr	Ser	Gly	Ala	Arg	Arg	Ala	Glu	50	55	60	
Ile	Ile	Phe	Leu	Cys	Ser	Pro	Val	Lys	Ala	Thr	Leu	Val	Gln	Leu	Glu	65	70	75	80
Glu	Leu	Asn	Gln	Leu	Ser	Leu	Glu	Thr	Ala	Leu	Ile	Thr	Asp	Val	Gly	85	90	95	
Ser	Thr	Lys	Val	Glu	Ile	Asn	Gln	Leu	Ala	Thr	Lys	Leu	Asn	Met	Lys	100	105	110	
Asn	Phe	Ile	Gly	Gly	His	Pro	Met	Ala	Gly	Ser	His	Lys	Ser	Gly	Val	115	120	125	
Thr	Ala	Ala	Asp	Glu	Arg	Leu	Phe	Glu	Asn	Ala	Tyr	Tyr	Ile	Phe	Thr	130	135	140	
Asp	Asp	His	Gly	Glu	Lys	Asn	Lys	Gln	Ile	Gln	Glu	Leu	Gln	Thr	Leu	145	150	155	160
Leu	Lys	Gly	Thr	His	Ala	Lys	Phe	Ile	Thr	Met	Pro	Ala	Gln	Glu	His	165	170	175	
Asp	Glu	Ile	Thr	Gly	Ala	Leu	Ser	His	Leu	Pro	His	Ile	Val	Ala	Ala	180	185	190	
Ala	Leu	Val	Asn	Glu	Ser	Gln	Gln	Leu	Asn	Thr	Thr	Tyr	Pro	Arg	Ala	195	200	205	
Gln	Gln	Leu	Ala	Ala	Gly	Gly	Phe	Arg	Asp	Ile	Thr	Arg	Ile	Ala	Ser	210	215	220	
Ser	Asp	Ala	Thr	Met	Trp	Thr	Asp	Ile	Leu	Leu	Ser	Asn	Arg	Leu	Val	225	230	235	240
Leu	Leu	Asp	Leu	Leu	Glu	Asn	Trp	Gln	Lys	Glu	Met	Thr	Thr	Val	Cys	245	250	255	
Gln	Trp	Leu	Thr	Glu	Lys	Asn	Ala	Pro	Ala	Ile	Arg	Asn	Phe	Phe	Asp	260	265	270	
Lys	Ala	Lys	Glu	Thr	Arg	Ala	Gln	Leu	Pro	Ile	His	Lys	Glu	Gly	Ala	275	280	285	
Ile	Pro	Ala	Phe	Tyr	Asp	Leu	Phe	Val	Asp	Val	Pro	Asp	Gln	Pro	Gly	290	295	300	
Ile	Ile	Ala	Glu	Ile	Thr	Gln	Ile	Leu	Gly	Glu	Ala	Asp	Leu	Ser	Leu	305	310	315	320
Thr	Asn	Ile	Lys	Ile	Leu	Glu	Thr	Arg	Glu	Glu	Ile	Tyr	Gly	Ile	Leu	325	330	335	
Gln	Leu	Ser	Phe	Lys	Asn	Gln	Pro	Asp	Cys	Gln	Ala	Ala	Lys	Gln	Ile	340	345	350	
Leu	Ser	Lys	Lys	Thr	Asn	Tyr	Thr	Cys	Tyr	Glu	Lys					355	360		

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Figure 15L

ORF6

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atgaggggtgc aactacgtac aaatgtgaag catttacaag ggactctgat ggttcctagc 60
gacaaatcga tttcccatag aagtattatg tttggagcga tttcttctgg aaaaacgacg 120
attacaaatt ttctaagagg cgaagattgt ttaagtacct tagcggcggt tcgttcttta 180
gggtgtgaaca ttgaagatga cgggacgaca atcaccgttg agggggcgagg atttgagggc 240
ttaaaaaagg cgaagaatac aattgatgtt ggaaattcag ggacaacaat tcgtctgatg 300
ctgggcattt tagctggctg tccctttgaa acgcgcctag ctgggtgatgc gtctattgcc 360
aaacgaccaa tgaatcgtgt aatgcttcct ttaaaccaaa tgggagcgga atgtcaaggg 420
gttcagcaaa cggagtttcc gccaatctct attcgcgga ctcaaaattt gcaaccgatt 480
gactacacaa tgctgttgc aagtgtctca gttaaactcg ctattttatt cgccgctttg 540
caagccgagg gcacttctgt agtggttgag aaagaaaaga cacgtgatca tacagaagag 600
atgattcgac aatttggttg gacacttgaa gtagacggta aaaaaattat gttactgga 660
ccgcaacaat taacaggtca aaatgtggtg gttcctgggtg atatctcttc tgcagctttc 720
tttttagttg cgggtttagt agtcccagat agcgagatac ttctgaaaaa tgttggctta 780
aatcaaacgc ggacaggat tttagatgtg attaaaaaca tgggcgggtt cgtcactatt 840
ttaaatgaag atgaggccaa tcattctggc gattttacttg taaaaacgag tcaattaaca 900
gctacagaga ttggtggcgc tattatccca cgtttaattg atgagttacc gattattgct 960
ttgtaggcta ctcaggctac tggcacgaca atcattcgag atgcagaaga attgaaagtc 1020
aaagaaacca atcggattga tgcagtagcg aaagaattaa caattttagg cgccgacatc 1080
acgcctactg atgatggctt aattatacat ggaccaactt ctttacatgg tggaagagtt 1140
accagttatg gggatcatcg tatcgggatg atgttacaaa ttgctgcatt acttgtaaaa 1200
gaaggcactg ttgaattaga taaggctgaa gcagtttcag tttcttatcc agcatttttt 1260
gacgacttag aacgtttaag ttgttaa 1287

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Figure 15M

ORF6

Met	Arg	Val	Gln	Leu	Arg	Thr	Asn	Val	Lys	His	Leu	Gln	Gly	Thr	Leu
1				5					10					15	
Met	Val	Pro	Ser	Asp	Lys	Ser	Ile	Ser	His	Arg	Ser	Ile	Met	Phe	Gly
			20					25				30			
Ala	Ile	Ser	Ser	Gly	Lys	Thr	Thr	Ile	Thr	Asn	Phe	Leu	Arg	Gly	Glu
		35				40					45				
Asp	Cys	Leu	Ser	Thr	Leu	Ala	Phe	Arg	Ser	Leu	Gly	Val	Asn	Ile	
50					55					60					
Glu	Asp	Asp	Gly	Thr	Thr	Ile	Thr	Val	Glu	Gly	Arg	Gly	Phe	Ala	Gly
65				70					75						80
Leu	Lys	Lys	Ala	Lys	Asn	Thr	Ile	Asp	Val	Gly	Asn	Ser	Gly	Thr	Thr
			85					90					95		
Ile	Arg	Leu	Met	Leu	Gly	Ile	Leu	Ala	Gly	Cys	Pro	Phe	Glu	Thr	Arg
		100					105					110			
Leu	Ala	Gly	Asp	Ala	Ser	Ile	Ala	Lys	Arg	Pro	Met	Asn	Arg	Val	Met
	115						120					125			
Leu	Pro	Leu	Asn	Gln	Met	Gly	Ala	Glu	Cys	Gln	Gly	Val	Gln	Gln	Thr
	130				135						140				
Glu	Phe	Pro	Pro	Ile	Ser	Ile	Arg	Gly	Thr	Gln	Asn	Leu	Gln	Pro	Ile
145				150					155						160
Asp	Tyr	Thr	Met	Pro	Val	Ala	Ser	Ala	Gln	Val	Lys	Ser	Ala	Ile	Leu
			165						170					175	
Phe	Ala	Ala	Leu	Gln	Ala	Glu	Gly	Thr	Ser	Val	Val	Val	Glu	Lys	Glu
		180					185						190		
Lys	Thr	Arg	Asp	His	Thr	Glu	Glu	Met	Ile	Arg	Gln	Phe	Gly	Gly	Thr
	195					200					205				
Leu	Glu	Val	Asp	Gly	Lys	Lys	Ile	Met	Leu	Thr	Gly	Pro	Gln	Gln	Leu
	210				215						220				
Thr	Gly	Gln	Asn	Val	Val	Pro	Gly	Asp	Ile	Ser	Ser	Ala	Ala	Phe	
225				230					235					240	
Phe	Leu	Val	Ala	Gly	Leu	Val	Val	Pro	Asp	Ser	Glu	Ile	Leu	Leu	Lys
			245					250					255		
Asn	Val	Gly	Leu	Asn	Gln	Thr	Arg	Thr	Gly	Ile	Leu	Asp	Val	Ile	Lys
		260					265					270			
Asn	Met	Gly	Gly	Ser	Val	Thr	Ile	Leu	Asn	Glu	Asp	Glu	Ala	Asn	His
	275						280					285			
Ser	Gly	Asp	Leu	Leu	Val	Lys	Thr	Ser	Gln	Leu	Thr	Ala	Thr	Glu	Ile
	290				295						300				
Gly	Gly	Ala	Ile	Ile	Pro	Arg	Leu	Ile	Asp	Glu	Leu	Pro	Ile	Ile	Ala
305				310					315						320
Leu	Leu	Ala	Thr	Gln	Ala	Thr	Gly	Thr	Thr	Ile	Ile	Arg	Asp	Ala	Glu
			325						330					335	
Glu	Leu	Lys	Val	Lys	Glu	Thr	Asn	Arg	Ile	Asp	Ala	Val	Ala	Lys	Glu
		340					345					350			
Leu	Thr	Ile	Leu	Gly	Ala	Asp	Ile	Thr	Pro	Thr	Asp	Asp	Gly	Leu	Ile
	355					360					365				
Ile	His	Gly	Pro	Thr	Ser	Leu	His	Gly	Gly	Arg	Val	Thr	Ser	Tyr	Gly
	370				375						380				
Asp	His	Arg	Ile	Gly	Met	Met	Leu	Gln	Ile	Ala	Ala	Leu	Leu	Val	Lys
385				390					395						400
Glu	Gly	Thr	Val	Glu	Leu	Asp	Lys	Ala	Glu	Ala	Val	Ser	Val	Ser	Tyr
			405					410						415	
Pro	Ala	Phe	Phe	Asp	Asp	Leu	Glu	Arg	Leu	Ser	Cys				
			420					425							

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Figure 15N

ORF7

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atggaaaagca ttgttttaaat tggtttcatg ggtgcgggta aaacaactat cggccaaagt 60
ttggccaata aactgaagat gcctcatctt gatttagata cagcgtaaat tgaaaaaata 120
ggacgctcaa ttcttgacta tttcgaaaaa tatggtgaag cagctttccg agaacaggaa 180
acccaacttt taaaggagct gtcaaaaaat acagccgtcc tttcaactgg gggcgggatt 240
gttgtcggac cagaaaatcg tagcttatta aaatcttttc agcaagtgat ttatttacat 300
gcgacaccag aagagctggt aaaaagaatc acagaagata ctgaaaacca acggccctta 360
gctatagaac gttcttcaaa agaaatcatt actttgtttg agtctcgtaa aaatttttat 420
gaagaatgtg cgaagatgac aattgatcgc accaatcgct cgccagaaga aattatcaat 480
gaaattctgc aacaattaaa ggagtag 507
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Figure 150

ORF7

Met	Glu	Ser	Ile	Val	Leu	Ile	Gly	Phe	Met	Gly	Ala	Gly	Lys	Thr	
1				5				10					15		
Thr	Ile	Gly	Gln	Ser	Leu	Ala	Asn	Lys	Leu	Lys	Met	Pro	His	Leu	Asp
		20						25					30		
Leu	Asp	Thr	Ala	Leu	Ile	Glu	Lys	Ile	Gly	Arg	Ser	Ile	Pro	Asp	Tyr
	35						40					45			
Phe	Glu	Lys	Tyr	Gly	Glu	Ala	Ala	Phe	Arg	Glu	Gln	Glu	Thr	Gln	Leu
50						55					60				
Leu	Lys	Glu	Leu	Ser	Lys	Asn	Thr	Ala	Val	Leu	Ser	Thr	Gly	Gly	Gly
65					70					75				80	
Ile	Val	Val	Gly	Pro	Glu	Asn	Arg	Ser	Leu	Leu	Lys	Ser	Phe	Gln	Gln
				85					90					95	
Val	Ile	Tyr	Leu	His	Ala	Thr	Pro	Glu	Glu	Leu	Leu	Lys	Arg	Ile	Thr
		100						105						110	
Glu	Asp	Thr	Glu	Asn	Gln	Arg	Pro	Leu	Ala	Ile	Glu	Arg	Ser	Ser	Lys
		115					120					125			
Glu	Ile	Ile	Thr	Leu	Phe	Glu	Ser	Arg	Lys	Asn	Phe	Tyr	Glu	Glu	Cys
	130					135					140				
Ala	Lys	Met	Thr	Ile	Asp	Thr	Thr	Asn	Arg	Ser	Pro	Glu	Glu	Ile	Ile
145					150					155				160	
Asn	Glu	Ile	Leu	Gln	Gln	Leu	Lys	Glu							
				165											

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Figure 15P

ORF8

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atgaaagtgt gttatttagg tccgattggt tcctttacgt acagtgcaac gttggctgct 60
tttcctgaag ctacgttgat gccgtacgca tcgattccag cttgcttgaa agcaattgaa 120
cagcaagaag tggcatggag cattatccca atagaaaaca cgattgaagg aactgttaac 180
gcatcgatag attatttgta tcatcaagcg cagttacctg tccaagcaga gttagtttta 240
ccgattcaac aacaattaat ggtggcaaaa gagaatcaag cgatctggca acaaagtcag 300
aaaattttat cacatccgca agcattagct caatcgcaga tgtttctaga gaaaaacttt 360
ccagaagcga ttttagaagc aacaccttca acagcttacg ccgccaaata cattgcagaa 420
catccagaat taccttttgc agctattgca ccaaaacttt ctgcggaaat gtatgatttg 480
accattgttg aaaaaatat acaagattta tcggtaaatc aaacccgatt ttgggttctt 540
ggttctgaaa atttagcgat ttctttcccg ctatctgaga aaaaaataac actggcgatt 600
acgatgccaa gtaatgttcc tggtctctta cacaaagtat taagcgtgtt tagttggcga 660
gggattaatc ttagcaaaat agaatcgcg ccgttgaaaa caaagctagg agagtacttc 720
tttttaatgg acttagtgaa agatcaacca gaaaaattaa ttgaagcagc cttaacagaa 780
ctggaactca ttggtgcaga aataaaaatt ttaggggatt acccgatcta tgttttgtcc 840
acactttaa

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Figure 15Q

ORF8

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Met Lys Val Gly Tyr Leu Gly Pro Ile Gly Ser Phe Thr Tyr Ser Ala
1      5      10      15
Thr Leu Ala Ala Phe Pro Glu Ala Thr Leu Met Pro Tyr Ala Ser Ile
20      25      30
Pro Ala Cys Leu Lys Ala Ile Glu Gln Gln Glu Val Ala Trp Ser Ile
35      40      45
Ile Pro Ile Glu Asn Thr Ile Glu Gly Thr Val Asn Ala Ser Ile Asp
50      55      60
Tyr Leu Tyr His Gln Ala Gln Leu Pro Val Gln Ala Glu Leu Val Leu
65      70      75      80
Pro Ile Gln Gln Gln Leu Met Val Ala Lys Glu Asn Gln Ala Ile Trp
85      90      95
Gln Gln Ser Gln Lys Ile Leu Ser His Pro Gln Ala Leu Ala Gln Ser
100     105     110
Gln Met Phe Leu Glu Lys Asn Phe Pro Glu Ala Ile Leu Glu Ala Thr
115     120     125
Pro Ser Thr Ala Tyr Ala Ala Lys Tyr Ile Ala Glu His Pro Glu Leu
130     135     140
Pro Phe Ala Ala Ile Ala Pro Lys Leu Ser Ala Glu Met Tyr Asp Leu
145     150     155     160
Thr Ile Val Glu Lys Asn Ile Gln Asp Leu Ser Val Asn Gln Thr Arg
165     170     175
Phe Trp Val Leu Gly Ser Glu Asn Leu Ala Ile Ser Phe Pro Leu Ser
180     185     190
Glu Lys Lys Ile Thr Leu Ala Ile Thr Met Pro Ser Asn Val Pro Gly
195     200     205
Ser Leu His Lys Val Leu Ser Val Phe Ser Trp Arg Gly Ile Asn Leu
210     215     220
Ser Lys Ile Glu Ser Arg Pro Leu Lys Thr Lys Leu Gly Glu Tyr Phe
225     230     235     240
Phe Leu Met Asp Leu Val Lys Asp Gln Pro Glu Lys Leu Ile Glu Ala
245     250     255
Ala Leu Thr Glu Leu Glu Leu Ile Gly Ala Glu Ile Lys Ile Leu Gly
260     265     270
Asp Tyr Pro Ile Tyr Val Leu Ser Thr Leu
275     280

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